USGIN
U.S. Geoscience Information Network

Guidelines for implementation of USGIN metadata content recommendations in ISO 19139 XML metadata

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Creator:

USGIN Standards and Protocols Drafting Team

Editors:

Stephen M. Richard

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This document describes recommended practices for encoding the USGIN-recommended metadata content for geoscience resources following the USGIN profile for ISO19139 XML metadata.

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Contents

Introduction

This document provides guidance for implementing USGIN ISO 19139 XML metadata records as specified in detail in [Use of ISO metadata specifications to describe geoscience information resources](#) (USGIN, 2010a). The intention is to provide a quick summary of what is mandatory, what is optional but recommended, and how metadata content is encoded in XML to meet the content requirements outlined in [Metadata Recommendations for Geoscience Resources](#) (USGIN, 2010b). The document is divided into sections that first discuss elements required to meet USGIN specifications, then additional elements required for validation against the ISO19139 XML schema, then conditional elements that are mandatory for metadata description specific kinds of resources, and finally optional but recommended elements.

Mandatory elements (USGIN)

XML elements required to conform to USGIN [Metadata Recommendations for Geoscience Resources](#)(USGIN, 2010b).

Metadata date stamp

This is the date and time when the metadata record was created or most recently updated. This value should be auto-populated by any well-behaved metadata editor with a current date-time for the edit session or record generation ([see in instance document)](#).

```
<gmd:dateStamp>
  <!-- Requires an extended ISO 8601 formatted combined UTC date and time string (2009-11-17T10:00:00) -->
  <gco:DateTime>2010-01-14T10:00:00</gco:DateTime>
</gmd:dateStamp>
```

Metadata standard

USGIN profile conformant metadata is indicated by using "ISO-USGIN" for the value of this element ([see in instance document](#)).

```
<gmd:metadataStandardName>
  <gco:CharacterString>ISO-USGIN</gco:CharacterString>
</gmd:metadataStandardName>
```

Metadata standard version – for this version of the USGIN metadata profile use ([see in instance document](#)).

```
<gmd:metadataStandardVersion>
  <gco:CharacterString>1.2</gco:CharacterString>
</gmd:metadataStandardVersion>
```

USGIN resource type

USGIN makes this property mandatory to identify the USGIN resource type (see USGIN, 2010, "Resources of Interest"). Default USGIN value is "Dataset." Encode hierarchy by including hierarchyLevelName elements for all broader resource categories. E.g. default should also include a hierarchyLevelName="Collection" element. For services USGIN hierarchyLevelName.CharacterString is "Service". One obvious application of this property is for faceting search result according to resource type ([see in instance document)](#).

```
<gmd:hierarchyLevelName>
  <gco:CharacterString>Collection:Dataset</gco:CharacterString>
</gmd:hierarchyLevelName>
```

Metadata point of contact

Point of contact for the metadata record, e.g. for users to report errors, updates to metadata, etc. The contact must include at least one of {person name, organization name, or position name} as the contact party, and at least one of {telephone number or e-mail address} for contact information. If the e-mail contact is through a web page, put URL for web page in e-mail character string. These are all contained inside a CI_ResponsibleParty XML element, which is used in several other places in the metadata document with the same provisions.

The preferred contact party is an organization. If no contact party is reported, and organisationName element with the value 'missing' should be used to ensure that the document validates (see in instance document).

```
<gmd:organisationName>
  <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
</gmd:organisationName>
```

E-mail address is preferred.

```
<gmd:electronicMailAddress>
  <gco:CharacterString>metadata@azgs.az.gov</gco:CharacterString>
</gmd:electronicMailAddress>
```

ISO 19115 requires that a role be provided in any CI_ResponsibleParty element. The default value for the metadata contact is 'pointOfContact' as encoded below.

```
<gmd:role>
  <gmd:CI_RoleCode codeL-
    ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/-
    resources/Codelist/gmxCodelists.xml#CI_RoleCode" codeListValue="pointOfContact">point of
    contact
  </gmd:CI_RoleCode>
</gmd:role>
```

Resource citation –

The precise semantics of what an identification/citation is supposed to be are not very clearly articulated in ISO19115. For USGIN purposes, the citation is interpreted as information to identify the intellectual origin (or property) of the content in the described resource, along the lines of a citation in a scientific journal. If the metadata is about a digital representation of a published map or other document, the resource citation is to the original work as published. If the resource is 'born digital' the citation will be for the intellectual originator of the resource content. Required content for a CI_Citation XML element are title, date, and 'responsibleParty'.

Title

USGIN recommends using titles that inform the human reader about the dataset's content as well as its context. In many search interfaces, this title will be all that shows up in the initial search results, so it should clearly distinguish the described resource using meaningful language. (In instance document)

```
<gmd:title>
  <gco:CharacterString>USGIN minimum metadata example XML file</gco:CharacterString>
</gmd:title>
```

Publication date (Resource reference date)

Best practice is to include at least the date of publication or creation of the resource. The date of the resource reported in the citation corresponds to the resource's last update version according

to its update frequency. The required CI_Date XML element content includes a date-time value and dateType from a codelist. Date for USGIN profile uses xs:date data type, defined thus: "date uses the date/timeSevenPropertyModel, with hour, minute, and second required to be absent;" (http://www.w3.org/TR/xmlschema11-2) timezoneOffset is optional. (see in instance document)

```xml
<gmd:CI_Date>
  <gmd:date>
  <!-- Requires an extended ISO 8601 formatted combined UTC date and time string (2001-12-
  17T09:30:47). XML data type xs:date does not require time zone -->
    <gco:DateTime>2010-01-14T09:30:47</gco:DateTime>
  </gmd:date>
  <gmd:dateType>
  <!—ISO codelist that applies here: {creation, publication, revision} -->
    <gmd:CI_DateTypeCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/-
    ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode" codeList-
    Value="publication">publication</gmd:CI_DateTypeCode>
  </gmd:dateType>
</gmd:CI_Date>
```

Originator (Resource responsible party)

A CI_ResponsibleParty element that provides at least the name and contact telephone number or e-mail address for the party responsible for a cited resource. If the e-mail contact is through a web page, put URL for web page in e-mail character string. 'Responsible' may be interpreted in many ways, and the required 'role' property should be used to specify the nature of the 'responsibility' as clearly as possible (see role codes listed below'.

Example of position name for contact or originator party (to instance document):

```xml
<gmd:postionName>
  <gco:CharacterString>Database manager</gco:CharacterString>
</gmd:positionName>
```

Example of telephone number for contact or originator point (to instance document):

```xml
<gmd:CI_Telephone>
  <gmd:voice>
    <gco:CharacterString>520-770-3500</gco:CharacterString>
  </gmd:voice>
</gmd:CI_Telephone>
```

Applicable role code value from the ISO codelist: {resourceProvider, custodian, owner, user, distributor, originator, pointOfContact, principalInvestigator, processor, publisher, author}. Default citation cited responsible party role is 'author' (to instance document).

```xml
<gmd:role>
  <gmd:CI_RoleCode codeL-
  ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Codel
  ist/gmxCodelists.xml CI_RoleCode" codeListValue="author">author</gmd:CI_RoleCode>
</gmd:role>
```

Description (Abstract)

A free text summary of the content, significance, purpose, scope, etc. of the resource. Exactly one value. Recommended practice is to put any descriptive information about the resource that will be useful for understanding and evaluating the resource in this text. Specific information

about access constraints or lineage (provenance) may also be included in separate, optional content elements specific to that information (see below). (see in instance document)

```
<gmd:abstract>
  <gco:CharacterString>Summary of resource content, description of data structure,
  provenance, quality and any important access limitations.</gco:CharacterString>
</gmd:abstract>
```

Distribution

A USGIN metadata record must include information indicating at least one method to obtain (access) the described resource. For a physical resource, this must be at least a text description of ordering process (orderingInstructions element); for online resources, a URL should be provided that will either access the resource directly (via download, web service, or a web application) or access a web location for requesting access to the resource. This information is encoded in the distributionInformation section of the ISO19139 XML metadata record. Multiple methods of accessing a resource should be included in the metadata record if they are available. These might be offered from different distributors, in different formats, or as different kinds of representation (e.g. map image, vector GIS data, vector graphics image).

Access Instructions

Text instructions for how to access the resource; required for a physical resource (rock sample, hard copy book), otherwise optional. Online resource access is described implicitly by including an online linkage in a digital transfer options element (MD_DigitalTransferOptions, see below). (see in instance document)

```
<gmd:orderingInstructions>
  <gco:CharacterString>Text that clearly describes the process to obtain access to
    a physical resource, including necessary contact e-mail or telephone, ac-
    cess restrictions, and cost.
  </gco:CharacterString>
</gmd:orderingInstructions>
```

Distribution contact

The party to contact about accessing the resource. A CI_ResponsibleParty element that provides at least a name and a contact telephone number or e-mail address for the party responsible for distribution of the resource described by the metadata record. If the e-mail contact is through a web page, put URL for web page in e-mail character string. The 'role' property should be used to specify the nature of the 'responsibility' as clearly as possible (see role codes listed below').

A person, organization, or position name may be provided. This example shows an organization name. If no name is available, and organization name 'missing' should be provided (see in instance document):

```
<gmd:organisationName>
  <gco:CharacterString>Nevada Bureau of Mines and Geology</gco:CharacterString>
</gmd:organisationName >
```

Example of telephone number for distributor contact; an e-mail address may be provided in addition or as an alternative (see in instance document).

```
<gmd:CI_Telephone>
  <gmd:voice>
    <gco:CharacterString>860-7270-3524</gco:CharacterString>
  </gmd:voice>
</gmd:CI_Telephone>
```

Applicable role code value from the ISO codelist: {resourceProvider, distributor} (see in instance document).

```
<gmd:role>
  <gmd:CI_RoleCode codeL-
    ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/-
    Codelist/gmxCodelists.xml#CI_RoleCode" codeList-
    Value="distributor">distributor</gmd:CI_RoleCode>
</gmd:role>
```

Online linkage

A URL pointing to a resource or resource webpage. If the resource is available online, a URL or http URI that can be used to get a useful representation of the resource is required. A URL is the minimum content required if a link is included. Optionally, a Link Function term from the ISO19115 OnlineFunctionCode controlled vocabulary specifies what a HTTP GET using the URL will invoke. The link might return an html page, electronic document in some other format, an end point for a service, an online application that requires user interaction, etc.

Simple link distribution

For a simple link to download a file resource, a URL and online function code with value="download" is all that is required. If the distribution is through a web application, or a link to an online order form for offline access, a description element should be included with a description of the included link function. (see in instance document)

```
<gmd:MD_DigitalTransferOptions>
  <gmd:onLine>
    <gmd:CI_OnlineResource>
  <!-- The linkage element should contain the complete URL to access the resource directly. -->
      <gmd:linkage>
        <gmd:URL>http://azgs.az.gov/resource/00C02E67-F1ED-473D-A240-
          068CCB041A73/borehole_report.pdf</gmd:URL>
      </gmd:linkage>
  <!-- optional description element if necessary -->
      <gmd:description>
        <gco:CharacterString>Description of link function, recommended if the link
          is not a simple file download</gco:CharacterString>
      </gmd:description>
  <!-- For file-based resources, the optional applicationProfile may be used to indicate the software application needed to use the linked
  file resource. The applicationProfile character string should specify the software using the following recommended syntax:
  "vendor:application name/application version", e.g. "Microsoft:Word/2007", or "ESRI:ArcGIS/9.3" -->
    <!-- CI_OnlineFunctionCode names: {download, offlineAccess, order, search} -->
      <gmd:function>
        <gmd:CI_OnLineFunctionCode codeL-
          ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/-
          resources/Codelist/gmxCodelists.xml#CI_OnlineFunctionCode" codeListValue="download">
          download</gmd:CI_OnLineFunctionCode>
      </gmd:function>
    </gmd:CI_OnlineResource>
  </gmd:onLine>
</gmd:MD_DigitalTransferOptions>
```

Web service distribution

This is an example of link information for a service-based distribution that requires more information providing context for the link to allow machine processing to access the resource with minimum user input.

```
<gmd:MD_DigitalTransferOptions>
```

```xml
    <gmd:onLine>
      <gmd:CI_OnlineResource>
        <gmd:linkage>
          <gmd:URL>http://services.azgs.az.gov/ArcGIS/services/aasggeothermal/NMBorehole-
            Temperatures/MapServer/WFSServer?request=GetCapabilities&amp;service=WFS
          </gmd:URL>
        </gmd:linkage>
```
<!-- The protocol attribute specifies protocol in the network stack on top of the base protocol that is specified by the prefix of the URL (http: or ftp: typically), and the USGIN recommends that this property be used to encode the serviceType. -->
```xml
        <gmd:protocol>
          <gco:CharacterString> OGC:WFS </gco:CharacterString>
        </gmd:protocol>
```
<!-- For links to resources for which the gmd:protocol (service type) along with the prefix on the link URL do not provide sufficient information to guide client software, the applicationProfile property is used to indicate a profile on the serviceType or some variation in document encoding or content conventions. For example WFS services may offer different feature types, a catalog may offer different metadata encoding, or a resource–oriented service may offer representations using different encoding schemes. The same scheme may be used with different conventions, for instance different profiles for the use of ISO19139 or csw:record XML metadata encoding. RDF representations may be offered in XML, Turtle, or N3 encoding. -->
```xml
        <gmd:applicationProfile>
          <gco:CharacterString>BoreholeTemperature</gco:CharacterString>
        </gmd:applicationProfile>
```
<!-- The CI_OnlineResource/name element may duplicate the file name if the URL is a link to a file, but it is recommended to provide a user–friendly label for the file that could be presented in a user interface. -->
```xml
        <gmd:name>
          <gco:CharacterString>serviceDescription</gco:CharacterString>
        </gmd:name>
```
<!-- CI_OnlineResource/function is required by USGIN to indicate how linkage is to be used. ISO codelist does not provide a value for webService online resource function, so the North American Profile codelist is used. Note the different approach to codeListValue in the NAP definitions. NAP codelist extends ISO codelist with {upload, webService, emailService, browsing, fileAccess}. -->
```xml
        <gmd:function>
          <gmd:CI_OnLineFunctionCode codeL-
            ist=http://www.fgdc.gov/nap/metadata/register/registerItemClasses.html#IC_88 codeList-
            Value="381">webService</gmd:CI_OnLineFunctionCode>

        </gmd:function>
      </gmd:CI_OnlineResource>
    </gmd:onLine>
</gmd:MD_DigitalTransferOptions>
```

Mandatory elements (ISO)

The following elements must be populated as describe in order to validate an ISO 19139 MD_Metadata element according to the USGIN recommendations. Only the required elements are discussed here, examples only include the immediately containing elements from the xml schema. For an example of a complete record with all of these elements in context, see the USGIN ISO 19139 Minimum Dataset Metadata section.

Metadata file identifier
The value of this element is a unique identifier for the metadata record. USGIN recommends using a valid Universally Unique Identifier (UUID). Values are typically assigned automatically when metadata records are created using standard operating system functions available on all current operating systems. This value is used in a distributed metadata system to determine if two metadata record instances are the same record, normally in a harvesting or de-duplication workflow. If records have identical fileIdentifiers, the normal procedure would be to compare the dateStamp values (see below) and use the more recently dated record. Alternatively a diff-based conflict resolution process may be run to compare the records and automatically or with operator assistance determine which element values to keep (see in instance document).

```
<gmd:fileIdentifier>
  <gco:CharacterString>08fb00c8-0882-4bf7-b07f-fd37050c5efc</gco:CharacterString>
</gmd:fileIdentifier>
```

Metadata language

The value specifies the language of content in the metadata record using a code from a controlled vocabulary of three letter abbreviations for languages defined by ISO ISO639-2/T. USGIN convention is to assign the default value 'eng' if no value is provided (see in instance document).

```
<gmd:language>
  <gco:CharacterString>eng</gco:CharacterString>
</gmd:language>
```

Metadata character set

The ISO 19115 metadata content specification defines a controlled vocabulary of abbreviations for standard character encodings, used as in the example below. The default values are indicated in the example below. The ISO19139 encoding requires that the codelist, and codeListValue attributes are present. The element value ('UTF-8') is not mandatory, but USGIN recommends including it as in the example to accommodate various existing interpretations of how the values should be presented. (see in instance document)

```
<gmd:characterSet>
  </gmd:MD_CharacterSetCode codeL-
    ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Cod
    elist/gmxCodelists.xml#MD_CharacterSetCode" codeListValue="utf8">UTF-8
  </gmd:MD_CharacterSetCode>
</gmd:characterSet>
```

ISO Resource type (hierarchy level)

This element is required by the ISO19139 XML schema, and will normally be populated as follows with the default values. The ISO19115 content model defines a controlled vocabulary of values as follows: {attribute, attributeType, collectionHardware, collectionSession, dataset, series, nonGeographicDataset, dimensionGroup, feature, featureType, propertyType, fieldSession, software, service, model, tile}. Unfortunately the ISO definitions of these terms is ambiguous in many cases. Default value is 'datataset'. The other values that finds common use is 'service' to indicate that the metadata record describes a service resource, with the implication that the identificationInfo content element (see below) will be SV_ServiceIdentification. The 'series' value is used by some organizations to create metadata records for complex aggregate datasets; USGIN recommends that this information be encoded using the logically equivalent (and less ambiguous) encoding offered by the MD_AggregationInformation element, but this is outside the scope of a simple, minimal metadata record. (see in instance document)

```
<gmd:hierarchyLevel>
    <gmd:MD_ScopeCode codeList="http://standards.iso.org/ittf/PubliclyAvailable-
      Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_ScopeCode" codeList-
      Value="dataset">dataset</gmd:MD_ScopeCode>
</gmd:hierarchyLevel>
```

Resource status

A term from a controlled vocabulary indicating the status of the resource in the data life cycle. Value is from MD_ProgressCode names: {completed, historicalArchive, obsolete, onGoing,

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planned, required, underDevelopment}. Obsolete is synonymous with deprecated. The default value is 'completed' ([see in instance document](#)).

```xml
<gmd:status>
  <gmd:MD_ProgressCode
    codeL-
    ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/Cod
    elist/gmxCodelists.xml#MD_ProgressCode" codeList-
    Value="completed">completed</gmd:MD_ProgressCode>
</gmd:status>
```

Resource language

Specifies the language of the content in the described resource using a code from a controlled vocabulary of three letter abbreviations for languages defined by ISO ISO639-2/T. Multiple instances of this element indicate that the linguistic content of the resource is available in multiple languages. Default value is 'eng' ([see in instance document](#)).

```xml
<!-- ISO 639-2/T three-letter language code in lowercase (http://www.loc.gov/standards/iso639-2/). -->
<gmd:language>
  <gco:CharacterString>eng</gco:CharacterString>
</gmd:language>
```

Conditionally required elements

Resource Identifier

If an identifier is defined for a cited resource (in the identificationInfo/citation section of an ISO XML metadata record), is must be included in the metadata record. This condition in general can only be enforced by editorial inspection by someone familiar enough with the citation to know if an identifier is available, so this rule is mostly guidance for best practice. This element content value is an identifier for the cited resource, with no assumption that it will use http protocol. The identifier may be resolvable to a web location if a protocol prefix specifies an identifier scheme that is resolvable (e.g. http, urn…), but this is not necessary for a valid document, and should not be assumed when processing metadata documents. For USGIN, IF the Citation has an identifier that is different from the identifier for the described resource (MD_Metadata/dataSetURI), it must be included here. RS_Identifier may substitute for MD_Identifier in the ISO19139 schema, but the USGIN profile requires use of MD_Identifer. If additional codespace and version content is associated with the identifier, it should be encoded as MD_Identifier/authority/ CI_Citation/ alternateTitle and MD_Identifier/ authority/ CI_Citation/ edition

Resource identifier(s) following any public or institutional standard. Identifier consists of an identifier string and if applicable a **Resource ID Protocol** identifier string that specifies the protocol for the resource ID standard. For example: undefined, ISBN-10, ISBN-13, ISSN, URN, URI, IRI, DOI, HTTP, SSN, etc. ([see in instance document](#))
Examples: doi:10.1000/182; isbn:0-671-62964-6; issn:1935-6862; azgs:OFR-10-02
Many protocols (including any URI) build the identifier for the protocol into the identifier string.

```xml
<gmd:MD_Identifier>
  <!-- 13 digit ISBN example -->
  <gmd:code>
    <gco:CharacterString>isbn:000-0-000-00000-0</gco:CharacterString>
  </gmd:code>
</gmd:MD_Identifier>
```

Resource point of contact

CI_ResponsibleParty element that contains contact information for the resource steward, custodian, or curator. This information is mandatory for physical resources such as core, cuttings, samples, manuscripts. It is also best practice to specify the source of a resource here if that is different from the distributor and from the citation point of contact (e.g. the author, compiler or originator). For instance a geologic map digital data set would have the citation point of contact as the authors of the map; the digital data may be under the custodianship of a state geological survey that provides the data to a third part to host for online access. The resource point of contact would be the custodial geological survey and the distributor point of contact would be the third part that is actually serving the data (see in instance document).

The preferred contact party is an organization. If no contact party is reported, an organisation-Name element with the value 'missing' should be used to ensure that the document validates.

```
<gmd:organisationName>
  <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
</gmd:organisationName>
```

E-mail address is preferred.

```
<gmd:electronicMailAddress>
  <gco:CharacterString>metadata@azgs.az.gov</gco:CharacterString>
</gmd:electronicMailAddress>
```

ISO 19115 requires that a role be provided in any CI_ResponsibleParty element. The code list includes {resourceProvider, custodian, owner, user, distributor, originator, pointOfContact, principalInvestigator, processor, publisher, author}. The default value for the resource contact contact is 'custodian' as encoded below.

```
<gmd:role>
  <gmd:CI_RoleCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/-
    ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_RoleCode" codeList-
    Value="custodian">custodian</gmd:CI_RoleCode>
</gmd:role>
```

Geographic extent

Defines the spatial (horizontal and vertical) and temporal region to which the content of the resource applies. Required for resources that can be located geographically (which will be the case for most geoscience resources of interest). Geographic extents specified using place names should be placed in the keywords section with the keyword theme 'place'. USGIN profile requires that if an EX_Extent/geographicElement is supplied, it include a geographic bounding box with bounding latitude and longitude expressed using WGS 84 decimal degrees. The corner coordinates for the geographic bounding box must not coincide in one point, because this may result in fatal errors with some CSW implementations. Point locations must thus be represented as tiny rectangles. USGIN recommended practice is to place the actual point location in the lower left (southwest) corner of the rectangle (see in instance document).

```
<gmd:geographicElement>
  <gmd:EX_GeographicBoundingBox>
    <gmd:extentTypeCode>
      <gco:Boolean>1</gco:Boolean>
    </gmd:extentTypeCode>
    <gmd:westBoundLongitude>
      <gco:Decimal>-109.92</gco:Decimal>
    </gmd:westBoundLongitude>
    <gmd:eastBoundLongitude>
      <gco:Decimal>-109.91</gco:Decimal>
```

```
    </gmd:eastBoundLongitude>
    <gmd:southBoundLatitude>
      <gco:Decimal>34.7</gco:Decimal>
    </gmd:southBoundLatitude>
    <gmd:northBoundLatitude>
      <gco:Decimal>34.8</gco:Decimal>
    </gmd:northBoundLatitude>
  </gmd:EX_GeographicBoundingBox>
</gmd:geographicElement>
```

Vertical extent

Vertical extent is required for resources that pertain to a subsurface, ocean, or atmosphere location. If no vertical extent is specified, it is assumed to be the current Earth surface. Use EPSG register of geodetic parameters such as at http://www.epsg-registry.org/. The default VerticalCRS is World mean sea level (MSL): urn:ogc:def:crs:EPSG::5714, with elevation reported positive upward in meters.

```
<gmd:EX_VerticalExtent>
  <gmd:minimumValue>
    <gco:Real>-100</gco:Real>
  </gmd:minimumValue>
  <gmd:maximumValue>
    <gco:Real>200</gco:Real>
  </gmd:maximumValue>
  <gmd:verticalCRS xlink:href="urn:ogc:def:crs:EPSG::5714"/>
</gmd:EX_VerticalExtent>
```

For locations in wells, the vertical extent should be specified as depth interval below the surface. In this case, the coordinate reference system is the well bore trace, with the origin at the earth surface, depth measured in meter, with positive increasing downward. The coordinate reference system (CRS) should be reported as <verticalCRS xlink:href="localDatumElevation=xxx"/> where xxx is the surface elevation in meters. Note that when depth is reported, the elevation of the minimumValue is above the elevation of the maximum value.

```
<gmd:EX_VerticalExtent>
  <gmd:minimumValue>
    <gco:Real>24</gco:Real>
  </gmd:minimumValue>
  <gmd:maximumValue>
    <gco:Real>200</gco:Real>
  </gmd:maximumValue>
  <gmd:verticalCRS xlink:href="localDatumElevation=1740"/>
</gmd:EX_VerticalExtent>
```

Spatial data specification

Spatial data require information on spatial resolution and terms to categorize spatial representation type: raster (spatial array), polygon, lines, and points. Best practice is to include metadata for spatial representation if the described resource is a georeferenced dataset. The spatialRepresentationInfo property can be specified by one of 4 representation elements. MD_Georeferenceable is used if the resource is represented in coordinates (either in a raster or vector approach) that can be transformed to geospatial coordinates (lat-long or some projected coordinate system). Examples include a scanned air photo, or a representation of a map digitized using a graphics program such that the coordinates of the lines and points in the digital file are in page coordinates. In either case points in the image space can be matched to point on the Earth, allowing the coordinates for image points to be transformed to map geospatial coordinates. MD_Georectified is used for raster images that have been transformed such that there

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is a consistent geometric relationship between cells (pixels) in the image and patches on the Earth. MD_VectorSpatialRepresentation is used for datasets in which individual geographic features are described by arrays of coordinates that locate points in the Earth, which can be grouped to define line-paths, which can be assembled to define polygons and other more complex geometric features in 2 and 3 dimensions. These are the standard points, lines and polygons of GIS datasets. The example below is for a vector spatial representation.

```xml
<gmd:spatialRepresentationInfo>
  <gmd:MD_VectorSpatialRepresentation>
    <gmd:topologyLevel>
  <!-- MD_TopologyLevelCode names: {geometryOnly, topology1D, planarGraph, fullPlanarGraph, surfaceGraph, fullSurfaceGraph,
  topology3D, fullTopology3D, abstract}-->
      <gmd:MD_TopologyLevelCode
        codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/-
        resources/Codelist/gmxCodelists.xml#MD_TopologyLevelCode" codeListValue=
        "geometryOnly">geometry only</gmd:MD_TopologyLevelCode>
    </gmd:topologyLevel>
  <!-- (C-C) Identification of the objects used to represent features in the dataset - -->
    <gmd:geometricObjects>
      <gmd:MD_GeometricObjects>
        <gmd:geometricObjectType>
          <gmd:MD_GeometricObjectTypeCode
            codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/-
            resources/Codelist/gmxCodelists.xml#MD_GeometricObjectTypeCode"
            codeListValue="surface">surface</gmd:MD_GeometricObjectTypeCode>
        </gmd:geometricObjectType>
      </gmd:MD_GeometricObjects>
    </gmd:geometricObjects>
  </gmd:MD_VectorSpatialRepresentation>
</gmd:spatialRepresentationInfo>
```

Optional but recommended

Icons

It is recommended that citations for resource creator and metadata creator include a URL that will get an icon for display to brand content in presentation to user. USGIN recommends that these be included as an online resource in a special citation/CI_Responsible party element.

```xml
<gmd:CI_OnlineResource>
  <!-- Icon image file (e.g. tif, png, jpg, gif) for the party. This Icon will be displayed in search results to credit the metadata originator,
  resource originator, or distributor point of contact, depending on which icons are provided and conventions of that user interface-->
  <gmd:linkage>
    <gmd:URL>http://www.azgs.az.gov/logo/metadata/azgs.png</gmd:URL>
  </gmd:linkage>
  <!-- For URL's that indicate icon thumbnails, the CI_OnlineResource/name should be 'icon'. -->
  <gmd:name>
    <gco:CharacterString>icon</gco:CharacterString>
  </gmd:name>
</gmd:CI_OnlineResource>
```

Topic category

Term from a codelist define in ISO19115 uses to categorize the topic of the described resource. Optional, but included as mandatory in the FGDC North American Profile (not widely used) and in the INSPIRE profile (widely used in Europe). Most USGIN resources will have topicCategory = "geoscientificInformation", which is the default value for this profile, and recommends that a value be included for better interoperability with metadata from other domains. This is a catego-

rization useful for faceted search result that include resources from different topical domains. More specific topic categorization should be done using theme keywords. ([see in instance document](#))

```xml
<gmd:topicCategory>
  <!—ISO19115 MD_TopicCategoryCode names: {farming, biota, boundaries, climatologyMeterologyAtmosphere, economy, elevation, environment, geoscientificInformation, health, imageryBaseMapsEarthCover, intelligenceMilitary, inlandWater, location, oceans, planningCadastre, society, structure, transportation, utilitiesCommunication} -->
  <gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
</gmd:topicCategory>
```

Keywords

Best Practice for USGIN profile metadata is to supply keywords to facilitate the discovery of metadata records relevant to the user. USGIN best practice is to include keywords in English. The use of controlled vocabularies for keywords is a good way to enable faceted search and browse-interfaces for locating resources. The use of scoped keywords from community thesauri can also increase search efficiency. The ISO 19139 XML schema groups keywords according to keyword type, for which a controlled vocabulary is defined that includes the following terms--{discipline, place, stratum, temporal, theme} (see Table 1). See [Use of ISO metadata specifications to describe geoscience information resources](#) (USGIN, 2010) for additional information on keyword encoding, and for usage to document a Thesaurus from which a keyword was taken.

Table 1. ISO keyword type categories

Keyword type	Scope note (from FGDC CSDGM workbook, 2000-05-01 and ISO19115)
discipline	identifies a branch of instruction or specialized learning associated with the resource
place	the geographic location described by information in the resource, such as Montgomery County, Yellowstone National Park. Note USGIN recommendation that if the metadata describes a non-geospatial resource, the keyword 'non-geographic' be included as a place keyword.
stratum	the vertical location described by information in the resource, such as seafloor, seabed, troposphere, stratosphere
temporal	time reference described by information in the resource, such as pre-Columbian, World War II, Jurassic. Named geologic time eras for temporal extent should be included as temporal keywords as opposed to in the temporal extent section.
theme	the subject of information resource content, such as wetlands, vegetation, etc.

Place keywords

Place name keywords, including information like PLSS locations, should be placed in a MD_Keywords group with MD_Keywords/type = "place". A gazetteer thesaurus like USGS place names is one obvious candidate for a controlled vocabulary of place names. Here is an example:

```xml
<gmd:MD_Keywords>
  <gmd:keyword>
    <gco:CharacterString>Arizona</gco:CharacterString>
  </gmd:keyword>
```

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```xml
<gmd:keyword>
  <gco:CharacterString>T41N R27E S22 NE NE</gco:CharacterString>
</gmd:keyword>
<gmd:type>
  <gmd:MD_KeywordTypeCode  codeL-
    ist="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/-
    resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode" codeListValue="place">
    place</gmd:MD_KeywordTypeCode>
</gmd:type>
</gmd:MD_Keywords>
```

If a resource is not geospatially located, a place keyword 'non-geographic' should be included, encoded as follows:

```xml
<gmd:MD_Keywords>
  <gmd:keyword>
    <gco:CharacterString>non-geographic</gco:CharacterString>
  </gmd:keyword>
  <gmd:type>
    <gmd:MD_KeywordTypeCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/-
      ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_KeywordTypeCode"
      codeListValue="place">place</gmd:MD_KeywordTypeCode>
  </gmd:type>
</gmd:MD_Keywords>
```

Bibliographic citation

Published documents require a standard bibliographic citation (author, year, publisher, series, volume, page numbers, etc.) as specified by a publication style or guideline. Some example guidelines include USGS Suggestions to Authors and MLA Style Manual; the community will need to agree on any necessary conventions to use for citation syntax to improve interoperability. The citation authors should also appear in citation//CI_ResponsibleParty, the title will be in citation//title, and the publication date will be in citation/date (with dateType='publication'). In general, for web-accessible digital resources that are the typical items of interest that will be cited, full text searches are anticipated to be the most common use case. Unless clear examples of use cases requiring more disaggregated representation of citations in the metadata (e.g. separate attributes for publisher, larger work title, larger work editor, volume, issue number, etc…) we will stick to simple text blob citations.

```xml
<gmd:otherCitationDetails>
  <gco:CharacterString>Franklin, Michael, Halevy, Alon, and Maier, David, 2005,
    From databases to dataspaces: a new abstraction for information manage-
    ment: ACM SIGMOD Record, V. 34, No. 4, ISSN:0163-5808.
  </gco:CharacterString>
</gmd:otherCitationDetails>
```

Temporal extent

Required if resource has a Temporal range over which the resource was collected or is valid. If the resource pertains to specific named geologic time periods, those terms should be entered as Temporal keywords. For better interoperability of metadata, the temporal extent to which resource information applies is always encoded as an interval with a mandatory begin and end date/time, formatted using the xs:date (ISO 8601 date and time, time zone optional) format. If the extent is a single date or data/time, the begin and end data/time are the same. Temporal extents expressed using named geologic time eras should be specified as temporal keywords.

```xml
<gml:TimePeriod>
```

```xml
  <gml:begin>2003-02-13T12:28-08:00</gml:begin>
  <gml:end>2003-02-13T12:30-08:00</gml:end>
</gml:TimePeriod>
```

Resource format

Physical resources

For physical resources, the distributionFormat property is used to indicate the nature of the arti-
fact, e.g. core, rock sample, digital file, book, journal article. Table 2 (reproduced from USGIN
ISO metadata guidelines) provides a seed vocabulary for non-digital resource distribution format
for use with the ISO19115 distributionFormat name property.

Table 2. USGIN Distribution formats for non digital resources. URI for this codelist is
http://resources.usgin.org/registry/distributionFormatNames201001

Identifier	Name	Parent format	Scope
physicalArtifact	Physical ar-tifact		described resource is a physical ob-ject
sample	Sample	physicalArtifact	Use for uncategorized sample. A
sample:core	Core	sample	Cylindrical rock sample extracted from Earth with a coring drill
sample:cuttings	Cuttings	sample	Small rock fragments recovered from drilling process as sample of material being drilled
sample:fluid	Fluid	sample	Sample of a fluid
sample:handSample	Hand sam-ple	sample	Single piece or pieces of material.
hardcopy	Hard copy manuscript	physicalArtifact	A physical copy of a document on paper, film, or other similar material.
hardCopy:book	Book	hardcopy	Manuscript printed on paper, bound into a single volume
hardCopy:manuscript	Manuscript	hardCopy	Other printed or written representa-tion on physical media, usually paper or mylar, includes unbound books, index cards, loose notes, file folders of papers
hardCopy:printedImage	Printed im-age	hardCopy	Image on paper or other opaque or semi-opaque media.
printedImage:paperMap	Paper map	printedImage	Map image on a single sheet
hardCopy:filmImage	Film image	hardCopy	Image on film, viewed by passing light through the film. Includes single still images and collections of con-nected images for a movie.
fieldSite	Field site		resource is a station located on or in the Earth, generally of interest as a sampling site at which other re-

Identifier	Name	Parent format	Scope
			sources were collected or originated.
tapeRecording	Tape re-cording		use for sound resources that are recorded on magnetic tape.

Electronic resources

For resources with electronic representation, the distributionFormat is used to specify the file format of resource content e.g. tiff, xls. If a MIME format (http://www.iana.org/assignments/-media-types/) is defined for a digital file format, the MIME media-type code should be used. If no appropriate MIME type is registered with IANA, USGIN mandates that the distribution format for digital resources should specify the file format using the following pattern that includes vendor, application name, and file extension: [vendor:applicationName]/fileExtension. The vendor and application names may not be applicable, and could be omitted, but the '/' and file extension should always be present. If the format consists of a single file, the file extension is a three letter file-type abbreviation assigned by the vendor. If the format consists of a package of files (e.g. an ArcGIS file geodatabase), the file extension is a name that in most cases should be obvious from vendor usage. Table 3 provides some example format strings for digital files. The MD_Format/version value that accompanies the format name should indicate the version of application software if the format is specific to some version. See section 4.14 Distribution Format in USGIN ISO usage recommendations (USGIN, 2010).

Table 3. Example format strings for digital files. These are to be used only if an appropriate MIME type is not defined.

ESRI:ARCINFO/Coverage
/shapefile
ESRI:ARCINFO/e00
PitneyBowes:MapInfo/mid
ESRI:ArcGIS/mdb
ESRI:ArcGIS/fileGeodatabase
Microsoft:Access/mdb

```
<gmd:MD_Format>
  <gmd:name>
    <gco:CharacterString>Adobe:Acrobat/pdf</gco:CharacterString>
  </gmd:name>
  <gmd:version>
    <gco:CharacterString>8.0</gco:CharacterString>
  </gmd:version>
</gmd:MD_Format>
```

Quality statement

Text specification of the quality of the resource. ISO19139 does not include a free text element for describing data quality, so this information should be put in the abstract.

Lineage statement

A free-text statement of the resource's provenance.

```
<gmd:LI_Lineage>
  <gmd:statement>
```

```
    <gco:CharacterString>This dataset was digitized on screen from scanned,
      georferenced originals by the Arizona Geological Survey.</gco:CharacterString>
  </gmd:statement>
<gmd:LI_Lineage>
```

Constraints statement

A free-text statement describing any legal and usage constraints on the resource. This is a good place to put any legal disclaimer or licensing statements.

```
<gmd:MD_Constraints>
  <gmd:useLimitation>
    <gco:CharacterString>fair use, creative commons 3 license</gco:CharacterString>
  </gmd:useLimitation>
</gmd:MD_Constraints>
```

References

ISO 19115:2005, Geographic information - Metadata

ISO 19115/Cor.1:2006, Geographic information – Metadata, Technical Corrigendum

ISO 19119:2005, Geographic information - Services

ISO 19119:2005/Amd 1:2008, Extensions of the service metadata model

USGIN Team, 2010a, Use of ISO 19139 xml schema to describe geoscience information re-sources v1.1, Current version at http://repository.usgin.org/uri_gin/usgin/dlio/337.

USGIN Team, 2010b, Metadata Recommendations for Geoscience Resources, current version available at http://repository.usgin.org/uri_gin/usgin/dlio/335.

Example documents

USGIN ISO 19139 Minimum Dataset Metadata

In the following listing, text in green is comments; XML elements are in blue, XML attributes are in red, and attribute values are in purple. Content that will need to be provided for each resource and cannot normally be populated with automatic or default values, or with global values for a batch of related metadata (e.g from same distributor) are show in **large black text**.

This is an example record with minimal content necessary to meet the USGIN recommenda-tions and ISO 19139 schema requirements. Note that this example supersedes the example in section 8.1 of Use of ISO metadata specifications to describe geoscience information resources (USGIN, 2010).

```
<?xml version="1.0" encoding="UTF-8"?>
  <!-- USGIN ISO 19139 geospatial resource metadata record -->
<gmd:MD_Metadata
 xmlns:gmd="http://www.isotc211.org/2005/gmd"
 xmlns:gco="http://www.isotc211.org/2005/gco"
 xmlns:gml="http://www.opengis.net/gml"
 xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
 xsi:schemaLocation="http://www.isotc211.org/2005/gmd
http://schemas.opengis.net/csw/2.0.2/profiles/apiso/1.0.0/apiso.xsd">
  <!-- (M) A unique Identifier for the metadata record – USGIN recommends using a valid Universally Unique Identifier (UUID) -->
  <gmd:fileIdentifier>
    <gco:CharacterString>08fb00c8-0882-4bf7-b07f-fd37050c5efc</gco:CharacterString>
  </gmd:fileIdentifier>
```

```xml
   <!-- (M) Metadata language – USGIN recommends ISO's <ISO639-2/T three letter language code – lower case> formatting. -->
 <gmd:language>
    <gco:CharacterString>eng</gco:CharacterString>
 </gmd:language>
 <!-- (M) Metadata character set  – default is "utf8", codelist = napMD_CharacterSetCode. USGIN requires that a character set code is
  defined to facilitate CSW servers (deegree, GeoNetwork, etc.). MD_CharacterSetCode names: {ucs2, ucs4, utf7, utf8, utf16, 8859part1,
  8859part2, 8859part3, 8859part4, 8859part5, 8859part6, 8859part7, 8859part8, 8859part9, 8859part10, 8859part11, 8859part13,
  8859part14, 8859part15, 8859part16, jis, shiftJIS, eucJP, usAscii, ebcdic, eucKR, big5, GB2312} -->
 <gmd:characterSet>
    <gmd:MD_CharacterSetCode   codeList="http://standards.iso.org/ittf/PubliclyAvailable-
       Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_CharacterSetCode"
       codeListValue="utf8">UTF-8</gmd:MD_CharacterSetCode>
 </gmd:characterSet>
 <!-- (M) Resource type – MD_ScopeCode code names: {attribute, attributeType, collectionHardware, collectionSession, dataset, series,
  nonGeographicDataset, dimensionGroup, feature, featureType, propertyType, fieldSession, software, service, model, tile}. Default is
  dataset -->
 <gmd:hierarchyLevel>
      <gmd:MD_ScopeCode  codeList="http://standards.iso.org/ittf/PubliclyAvailable-
         Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_ScopeCode"
         codeListValue="dataset">dataset</gmd:MD_ScopeCode>
 </gmd:hierarchyLevel>
 <!-- USGIN makes this property mandatory to identify the USGIN resource type (see USGIN Profile, "Resources of Interest"). Default
  USGIN hierarchyLevelName.CharacterString is "Dataset." Encode hierarchy by including hierarchyLevelName elements for all broader
  resource categories. E.g. default should also include a hierarchyLevelName="Collection" element. For services USGIN
  hierarchyLevelName.CharacterString is "Service". -->
 <gmd:hierarchyLevelName>
    <gco:CharacterString>Dataset</gco:CharacterString>
 </gmd:hierarchyLevelName>
 <!--Metadata point of contact Point of contact for the metadata record, e.g. for users to report errors, updates to metadata, etc.--  >
 <gmd:contact>
    <gmd:CI_ResponsibleParty>
 <!-- (individualName + organisationName + positionName) > 0 -->
      <gmd:organisationName>
        <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
      </gmd:organisationName>
        <gmd:contactInfo>
          <gmd:CI_Contact>
 <!-- E-mail or phone number required, e-mail here -->
            <gmd:address>
              <gmd:CI_Address>
 <!-- Metadata point of contact e-mail address -->
                <gmd:electronicMailAddress>
                  <gco:CharacterString>metadata@azgs.az.gov</gco:CharacterString>
                </gmd:electronicMailAddress>
              </gmd:CI_Address>
            </gmd:address>
          </gmd:CI_Contact>
        </gmd:contactInfo>
   <!-- (M) ISO 19139 Mandatory: contact role. CI_RoleCode names: {resourceProvider, custodian, owner, user, distributor, originator,
pointOfContact, principalInvestigator, processor, publisher, author} – NAP expands with {collaborator, editor, mediator, rightsHolder}. --
>
      <gmd:role>
        <gmd:CI_RoleCode codeList="http://standards.iso.org/ittf/PubliclyAvailable-
           Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
           codeListValue="pointOfContact">point of contact</gmd:CI_RoleCode>
      </gmd:role>
    </gmd:CI_ResponsibleParty>
 </gmd:contact>
 <!-- (M) Metadata date stamp – USGIN profile requires use of dateStamp/gco:DateTime. This is the date and time when the metadata
  record was created or updated. Requires an xs:date UTC date and time string (2009-11-17T10:00:00). Time zone is optional, default
  assumed is GMT -->
 <gmd:dateStamp>
    <gco:DateTime>2010-01-14T10:00:00</gco:DateTime>
 </gmd:dateStamp>
 <!-- (M) metadata standard. USGIN profile conformant metadata is indicated by using "ISO-NAP-USGIN" -->
 <gmd:metadataStandardName>
    <gco:CharacterString>ISO-USGIN</gco:CharacterString>
```

```xml
    </gmd:metadataStandardName>
    <!-- (M) USGIN profile version -->
    <gmd:metadataStandardVersion>
       <gco:CharacterString>1.2</gco:CharacterString>
    </gmd:metadataStandardVersion>
    <!--   **************** -->
    <!-- (M) Resource identification information – MD_DataIdentification (dataset, dataset series) is default and most commonly used. In
    USGIN profile, services are mostly represented as distribution online resources to access datasets.  -->
    <gmd:identificationInfo>
       <!-- Resource Dataset or Dataset Series Identification -->
       <gmd:MD_DataIdentification>
         <gmd:citation>
    <!-- (M) Resource citation – For USGIN purposes, this should be viewed as information to identify the intellectual origin of the content
    in the described resource, along the lines of a citation in a scientific journal. Required content for a CI_Citation element are title, date,
    and responsibleParty -->
              <gmd:CI_Citation>
    <!-- (M) Resource title – USGIN recommends using titles that inform the human reader about the dataset's content as well as its
    context. -- >
              <gmd:title>
                <gco:CharacterString>USGIN minimum metadata example XML
                   file</gco:CharacterString>
              </gmd:title>
    <!-- (M) Resource reference date – Best practice is to include at least the date of publication or creation of the resource. The date of
    the resource reported in the citation corresponds to the resource's last update version according to its update frequency. CI_Date
    content includes a date and dateType. Date for USGIN profile uses xs:date data type, defined thus "date uses the
    date/timeSevenPropertyModel, with hour, minute, and second  required to be absent.  timezoneOffset remains optional"
    (http://www.w3.org/TR/xmlschema11-2). -->
              <gmd:date>
                <gmd:CI_Date>
    <!-- Requires an extended ISO 8601 formatted combined UTC date and time string (2001-12-17T09:30:47). If no time is available,
use 12:00:00. Time zone is optional, default is GMT -->
                   <gmd:date>
                     <gco:DateTime>2010-01-14T09:30:47</gco:DateTime>
                   </gmd:date>
                   <gmd:dateType>
    <!-- CI_DateTypeCode names: {creation, publication, revision}. -->
                     <gmd:CI_DateTypeCode codeList="http://standards.iso.org/ittf/PubliclyAvailable
                        Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_DateTypeCode"
                        codeListValue="publication">publication</gmd:CI_DateTypeCode>
                   </gmd:dateType>
                </gmd:CI_Date>
              </gmd:date>
    <!-- (C required if available) Unique resource identifier  – For USGIN purposes, this element content value should be only considered
    an identifier for the citation, without any assumption that it will use http protocol. The identifier may be resolvable to a URL, if a
    protocol prefix specifies an identifier scheme that is resolvable (e.g.     http, urn…), but this is not necessary for a valid document,
    and should not be assumed when processing metadata documents.
    For USGIN, IF the Citation has an identifier that is different from the identifier for the described resource (MD_Metadata/dataSetURI), it
    must be included here. RS_Identifier may substitute for MD_Identifier in the ISO19139 schema, but the USGIN profile requires use of
    MD_Identifer. If additional codespace and version content is associated with the identifier, it should be encoded as
    MD_Identifier/authority/ CI_Citation/ alternateTitle and MD_Identifier/ authority/ CI_Citation/ edition  -->
              <gmd:identifier>
                <gmd:MD_Identifier>
                   <gmd:code>
    <!-- 13 digit ISBN example -->
                     <gco:CharacterString>isbn:000-0-000-00000-0</gco:CharacterString>
                   </gmd:code>
                </gmd:MD_Identifier>
              </gmd:identifier>
    <!-- (M) Resource responsible party – The citation attribute provides information for citing the described resource. Citation is defined
    by Webster as "an act of quoting". The precise semantics of what an identification/citation is supposed to be are not very well
    articulated in ISO19115. For USGIN purposes, this should be viewed as information to identify the intellectual origin (or property) of
    the content in the described resource, along the lines of a citation in a scientific journal. Required content for a CI_Citation element
    are title, date, and 'responsibleParty'.  -->
              <gmd:citedResponsibleParty>
                <gmd:CI_ResponsibleParty>
```

```xml
<!-- (C individualName + organisationName + positionName) > 0; party name; organization name in this example. -->
              <gmd:organisationName>
                <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
              </gmd:organisationName>
<!-- (C phone + electronicMailAddress ) > 0; Contact Information; telephone number in this example -->
              <gmd:contactInfo>
                <gmd:CI_Contact>
                  <gmd:phone>
                    <gmd:CI_Telephone>
                      <gmd:voice>
                        <gco:CharacterString>520-770-3500</gco:CharacterString>
                      </gmd:voice>
                    </gmd:CI_Telephone>
                  </gmd:phone>
                </gmd:CI_Contact>
              </gmd:contactInfo>
<!-- (M) ISO 19139 Mandatory: contact role.  CI_RoleCode names: {resourceProvider, custodian, owner, user, distributor, originator,
 pointOfContact, principalInvestigator, processor, publisher, author}. Default in citation is author. -->
              <gmd:role>
                <gmd:CI_RoleCode codeList="http://standards.iso.org/ittf/PubliclyAvailable-
                    Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
                    codeListValue="author">author</gmd:CI_RoleCode>
              </gmd:role>
            </gmd:CI_ResponsibleParty>
          </gmd:citedResponsibleParty>
        </gmd:CI_Citation>
      </gmd:citation>
<!--(M) Resource Abstract – Free text summary of the content, significance, purpose, scope, etc. of the resource.-->
      <gmd:abstract>
        <gco:CharacterString>Example for the minimum required elements in a USGIN
          dataset metadata record.
        </gco:CharacterString>
      </gmd:abstract>
<!-- (M) Resource Status, from MD_ProgressCode names: {completed, historicalArchive, obsolete, onGoing, planned, required,
 underDevelopment}. Obsolete is synonymous with deprecated. Default is completed -->
      <gmd:status>
        <gmd:MD_ProgressCode codeList="http://standards.iso.org/ittf/PubliclyAvailable-
          Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#MD_ProgressCode"
          codeListValue="completed">completed</gmd:MD_ProgressCode>
      </gmd:status>
<!-- (C) mandatory for physical resources such as core, cuttings, samples, manuscripts).  – CI_ResponsibleParty element specifies
point of contact for resource steward. This will commonly be the same as the distributor point of contact. -->
      <gmd:pointOfContact>
        <gmd:CI_ResponsibleParty>
<!-- (C individualName + organisationName + positionName) > 0 -->
          <gmd:organisationName>
            <gco:CharacterString>Arizona Geological Survey</gco:CharacterString>
          </gmd:organisationName>
<!-- (C phone + electronicMailAddress) > 0) Contact Information. E-mail in this example -->
          <gmd:contactInfo>
            <gmd:CI_Contact>
              <gmd:address>
                <gmd:CI_Address>
                  <gmd:electronicMailAddress>
                    <gco:CharacterString>Steve.rauzi@azgs.az.gov</gco:CharacterString>
                  </gmd:electronicMailAddress>
                </gmd:CI_Address>
              </gmd:address>
            </gmd:CI_Contact>
          </gmd:contactInfo>
<!-- (M) ISO 19139 Mandatory: contact role.  CI_RoleCode values: {resourceProvider, custodian, owner, user, distributor, originator,
 pointOfContact, principalInvestigator, processor, publisher, author}. Default for resource contact is custodian-->
          <gmd:role>
            <gmd:CI_RoleCode codeList="http://standards.iso.org/ittf/PubliclyAvailable
                Standards/ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_RoleCode"
                codeListValue="custodian">custodian</gmd:CI_RoleCode>
          </gmd:role>
```

```
                    </gmd:CI_ResponsibleParty>
              </gmd:pointOfContact>
```
<!-- **(M)** Resource language – Multiple instances of this element indicate that the linguistic content of the resource is available in multiple languages. ISO 639–2/T three–letter language code in lowercase (http://www.loc.gov/standards/iso639–2/). Default is eng for English-->
```
              <gmd:language>
                  <gco:CharacterString>eng</gco:CharacterString>
              </gmd:language>
```
<!-- **(M)** Most USGIN resources will have topicCategory="geoscientificInformation", which is the default value for this profile. More specific topic categorization should be done using keywords. MD_TopicCategoryCode names: {farming, biota, boundaries, climatologyMeterologyAtmosphere, economy, elevation, environment, geoscientificInformation, health, imageryBaseMapsEarthCover, intelligenceMilitary, inlandWater, location, oceans, planningCadastre, society, structure, transportation, utilitiesCommunication} -->
```
              <gmd:topicCategory>
                  <gmd:MD_TopicCategoryCode>geoscientificInformation</gmd:MD_TopicCategoryCode>
              </gmd:topicCategory>
```
<!-- **(C mandatory if resource is geospatial**) Resource content extent – Defines the horizontal spatial region to which the content of the resource applies. Only required if resource has known geospatial extent; if resource is geospatial, but extent is unknown, use a nilReason on the gmd:extent element like this: <gmd:extent gco:nilReason="missing"/> with no element content. Otherwise, a resource content extent bounding box with bounding latitude and longitude expressed using WGS 84 decimal degrees is required if an EX_Extent/geographicElement is present. The corner coordinates for the geographic bounding box must not coincide in one point, because this may result in fatal errors with some CSW implementations. Point locations must thus be represented as tiny rectangles. USGIN recommended practice is to place the actual point location in the lower left corner of the rectangle. -->
```
              <gmd:extent>
                <gmd:EX_Extent>
                  <gmd:geographicElement>
                    <gmd:EX_GeographicBoundingBox>
                      <gmd:extentTypeCode>  <!-- default is 1, the resource is within the bounding box -->
                        <gco:Boolean>1</gco:Boolean>
                      </gmd:extentTypeCode>
                      <gmd:westBoundLongitude>
                        <gco:Decimal>-109.911001</gco:Decimal>
                      </gmd:westBoundLongitude>
                      <gmd:eastBoundLongitude>
                        <gco:Decimal>-109.910999</gco:Decimal>
                      </gmd:eastBoundLongitude>
                      <gmd:southBoundLatitude>
                        <gco:Decimal>34.772899</gco:Decimal>
                      </gmd:southBoundLatitude>
                      <gmd:northBoundLatitude>
                        <gco:Decimal>34.772901</gco:Decimal>
                      </gmd:northBoundLatitude>
                    </gmd:EX_GeographicBoundingBox>
                  </gmd:geographicElement>
                </gmd:EX_Extent>
              </gmd:extent>
          </gmd:MD_DataIdentification>
      </gmd:identificationInfo>
  <!-- ****************-->
```
Distribution section, information about how to acquire resource. Distributor contact information and either ordering instructions or a URL to access an electronic representation of the resource are mandatory. See USGIN (2010) for in depth discussion of USGIN recommendations for distribution information in ISO metadata records. -->
```
      <gmd:distributionInfo>
          <gmd:MD_Distribution>
            <gmd:distributor>
              <gmd:MD_Distributor>
                <gmd:distributorContact>
                  <gmd:CI_ResponsibleParty>
```
<!-- **(C individualName + organisationName + positionName)** > 0 -->
```
                    <gmd:organisationName>
                      <gco:CharacterString>**Nevada Bureau of Mines and Geology**
                      </gco:CharacterString>
                    </gmd:organisationName>
```
<!-- **(C phone + electronicMailAddress) > 0**) Contact Information. Telephone number in this example -->
```
                    <gmd:contactInfo>
                      <gmd:CI_Contact>
                        <gmd:phone>
                          <gmd:CI_Telephone>
```

```xml
                    <gmd:voice>
                       <gco:CharacterString>860-7270-3524</gco:CharacterString>
                     </gmd:voice>
                   </gmd:CI_Telephone>
                 </gmd:phone>
               </gmd:CI_Contact>
             </gmd:contactInfo>
             <gmd:role>
               <gmd:CI_RoleCode codeListValue="distributor"
                   codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_S
                   chemas/resources/Codelist/gmxCodelists.xml#CI_RoleCode">distributor</gmd:CI
                   _RoleCode>
             </gmd:role>
           </gmd:CI_ResponsibleParty>
         </gmd:distributorContact>

         <gmd:distributionOrderProcess>
           <gmd:MD_StandardOrderProcess>
  <!--(C) Ordering instructions are mandatory for physical resources or for electronic resources that are not accessible via URL -->
             <gmd:orderingInstructions>
               <gco:CharacterString>Text that clearly describes the process to obtain
                   access to a physical resource, including necessary contact e-
                   mail or telephone, access restrictions, and cost
               </gco:CharacterString>
             </gmd:orderingInstructions>
           </gmd:MD_StandardOrderProcess>
         </gmd:distributionOrderProcess>
       </gmd:MD_Distributor>
     </gmd:distributor>

     <gmd:transferOptions>
       <gmd:MD_DigitalTransferOptions>
  <!-- (C)  A URL is mandatory for electronic resources that can be accessed online; this example is for simple file-based resource
access -->
         <gmd:onLine>
           <gmd:CI_OnlineResource>
             <gmd:linkage>
  <!-- Ideally, the linkage element will contain the complete URL to access the resource directly; for resources that are accessed
  indirectly via a web page for ordering or browsing, this link may be for that location. See text for description of CI_OnlineResource
  element content to describe a service endpoint for accessing the resource. -->
               <gmd:URL>http://nbmg.unr.edu/resource/00C02E67-F1ED-473D-A240-
                   068CCB041A73/borehole_report.pdf
               </gmd:URL>
             </gmd:linkage>

             <gmd:function>
  <!-- (M if online element is present) CI_OnlineFunctionCode names: {download, offlineAccess, order, search} -->
               <gmd:CI_OnLineFunctionCode
                   codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/-
                   ISO_19139_Schemas/resources/Codelist/gmxCodelists.xml#CI_OnlineFunctionCode"
                   codeListValue="download">download</gmd:CI_OnLineFunctionCode>
             </gmd:function>
           </gmd:CI_OnlineResource>
         </gmd:onLine>
       </gmd:MD_DigitalTransferOptions>
     </gmd:transferOptions>
   </gmd:MD_Distribution>
  </gmd:distributionInfo>
</gmd:MD_Metadata>
```

Example online linkage information for a service-based re-source distribution.

```
  <gmd:transferOptions>
     <gmd:MD DigitalTransferOptions>
  <!-- (C)  For service-based distributions, USGIN recommends that the complete URL to access the standard service description
document (e.g. ogc getCapabilties, WSDL, WADL, OpenSearchDescription, etc.) be specified in a digitalTransferOptions element. The
associated gmd:name element should contain the string 'serviceDescription' to explicitly indicate that this link is for the service
description document. Additional digital transfer option elements may be included. -->
        <gmd:onLine>
           <gmd:CI_OnlineResource>
              <gmd:linkage>
  <!-- Ideally, the linkage element will contain the complete URL to access the resource directly; for resources that are accessed
   indirectly via a web page for ordering or browsing, this link may be for that location. See text for description of CI_OnlineResource
   element content to describe a service endpoint for accessing the resource. -->
              <gmd:URL> http://services.azgs.az.gov/ArcGIS/services/aasggeothermal/-
                        NMBoreholeTemperatures/MapServer/WFSServer?request=-
                        GetCapabilities&amp;service=WFS
              </gmd:URL>
           </gmd:linkage>

<!-- The protocol attribute specifies protocol in the network stack on top of the base protocol that is specified by the prefix of the URL
(http: or ftp: typically), and the USGIN recommends that this property be used to encode the serviceType. -->
           <gmd:protocol>
                 <gco:CharacterString>OGC:WFS</gco:CharacterString>
           </gmd:protocol>
  <!-- For links to resources for which the gmd:protocol (service type) along with the prefix on the link URL do not provide sufficient
information to guide client software, the applicationProfile property is used to indicate a profile on the serviceType or some variation in
document encoding or content conventions. For example WFS services may offer different feature types, a catalog may offer different
metadata encoding, or a resource-oriented service may offer representations using different encoding schemes. The same scheme may
be used with different conventions, for instance different profiles for the use of ISO19139 or csw:record XML metadata encoding. RDF
representations may be offered in XML, Turtle, or N3 encoding. -->
           <gmd:applicationProfile>
              <gco:CharacterString>BoreholeTemperature</gco:CharacterString>
           </gmd:applicationProfile>
  <!-- USGIN mandates that the onLineResource name for the required service description link be 'serviceDescription' -->
           <gmd:name>
              <gco:CharacterString>serviceDescription</gco:CharacterString>
           </gmd:name>
  <!-- CI_OnlineResource/function is required by USGIN to indicate how linkage is to be used. ISO codelist does not provide a value for
webService online resource function, so the North American Profile codelist is used. Note the different approach to codeListValue in the
NAP definitions. NAP codelist extends ISO codelist with {upload, webService, emailService, browsing, fileAccess}. -->
           <gmd:function>
              <gmd:CI_OnLineFunctionCode
                    codeList=http://www.fgdc.gov/nap/metadata/register/registerItemClasses.html#IC_88
                    codeListValue="381">webService</gmd:CI_OnLineFunctionCode>
           </gmd:function>
         </gmd:CI_OnlineResource>
       </gmd:onLine>
     </gmd:MD DigitalTransferOptions>
  </gmd:transferOptions>
```