Borehole IE final event

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Sponsor

AIRBUS

Borehole IE

113th OGC Technical Committee

Toulouse, France

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Making location count.

Context

- Borehole, Bore, Well or Wellbore & their associated data
  - many standards
  - each of them from a different point of view
- Gather several of those standards editors in the same (virtual) room
- Trying to avoid the yet another standard

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Objectives

- Create a generic conceptual model that can be used with existing models related directly or indirectly to a borehole.
- Have a series of useful concepts that can be used by data providers and mapped into existing models.

The tentative model should be designed to avoid

- creating yet another standard, especially in this field since software vendors already have well tested and widely used models / formats. Seek a common pattern for data providers to deliver to software vendors so they can easily map to their current products).
- reinventing existing specifications, but create a model that can harmonize with them

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Use cases – test cases

- (1) Managing national and regional borehole databank
- (2) From raw driller log to geologist validated one
- (3) Water well
- (5) Borehole for geotechnical investigation
- (6) Generic positioning of features on a borehole coordinate system
- (11) Testing 3D/4D geologic model coherence
- (13) Analysis on core & result positioning down the hole
- (14) Serving borehole events from an active drill site for off-site science support
- (16) Oil & gas Well / Borehole description

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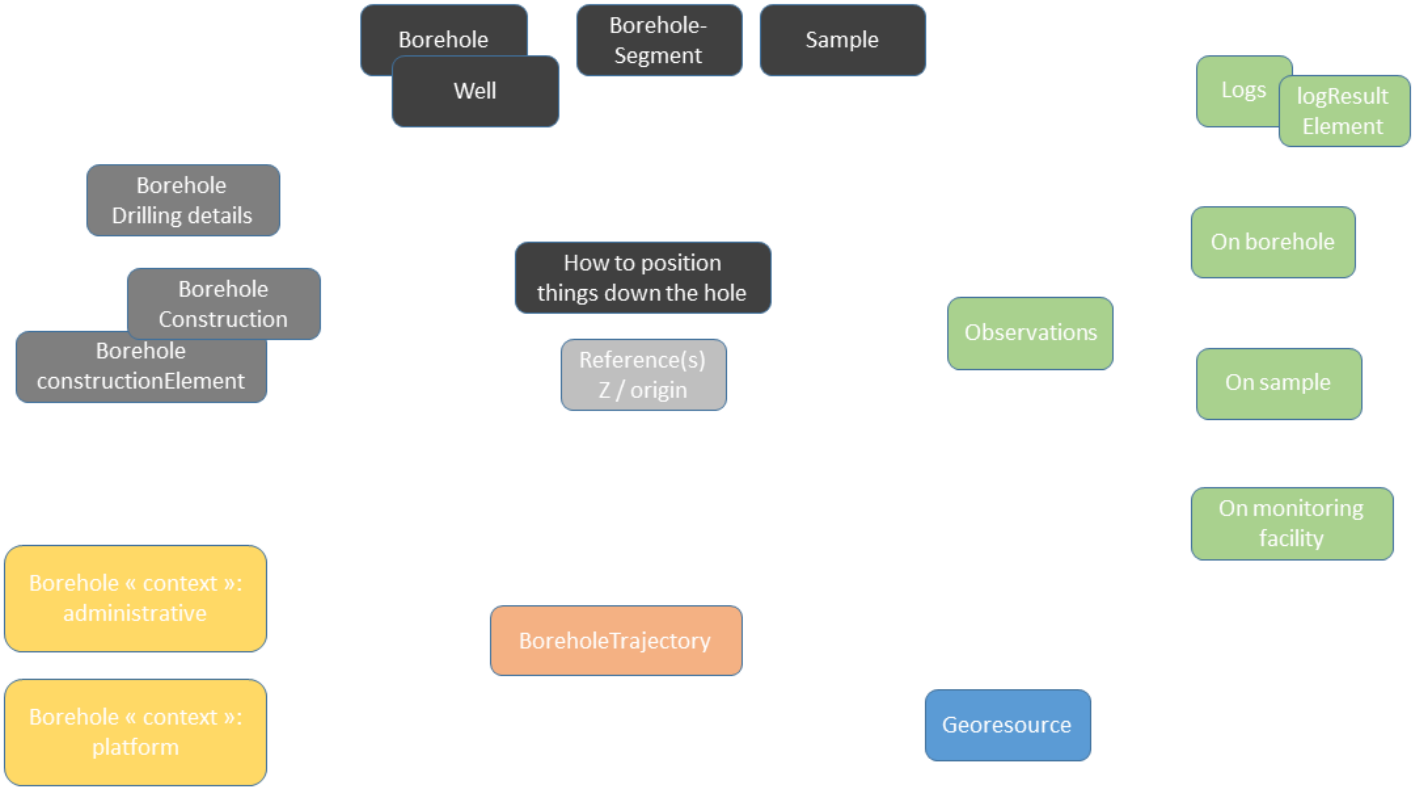
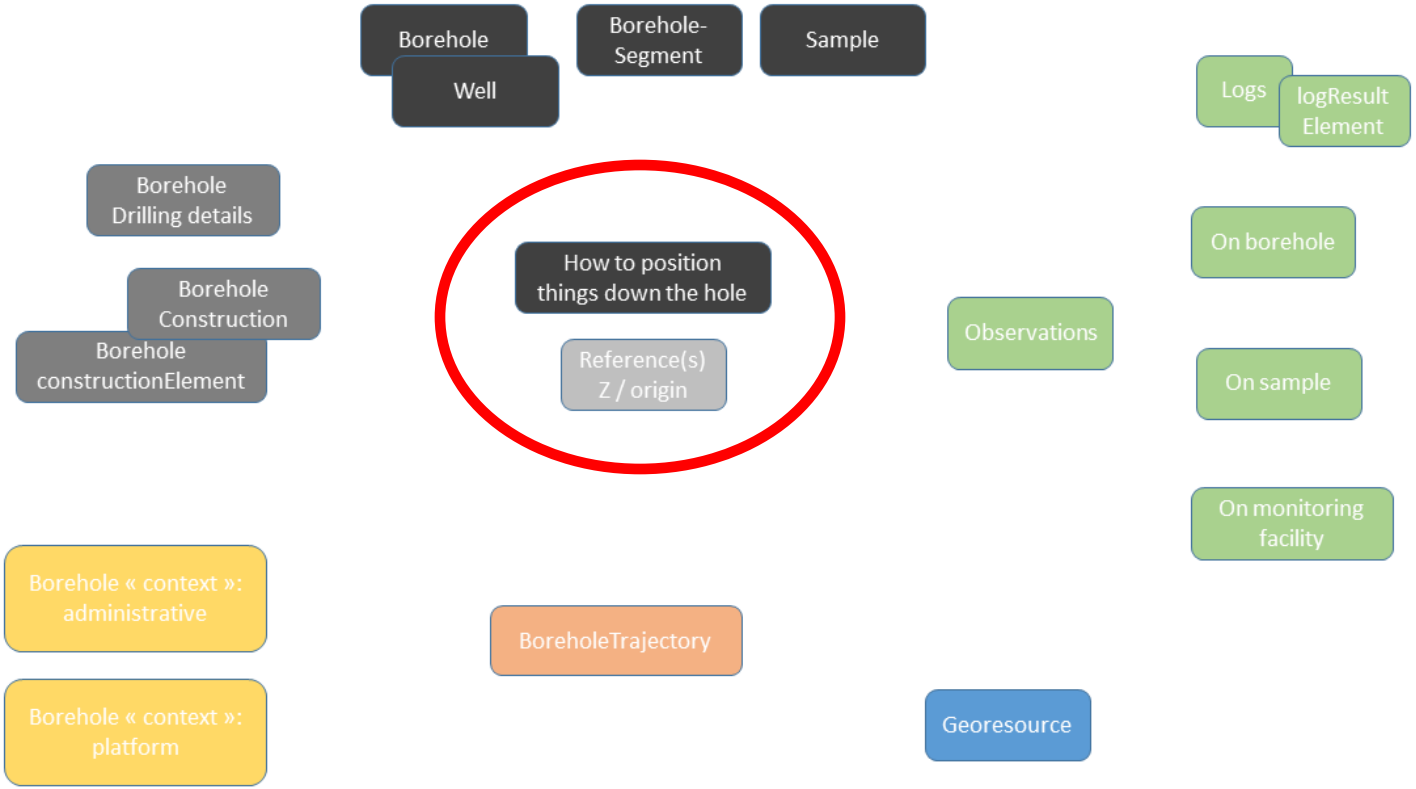
Vocabulary needs

- Quite a list



Vocabulary needs

- With a shared aspect



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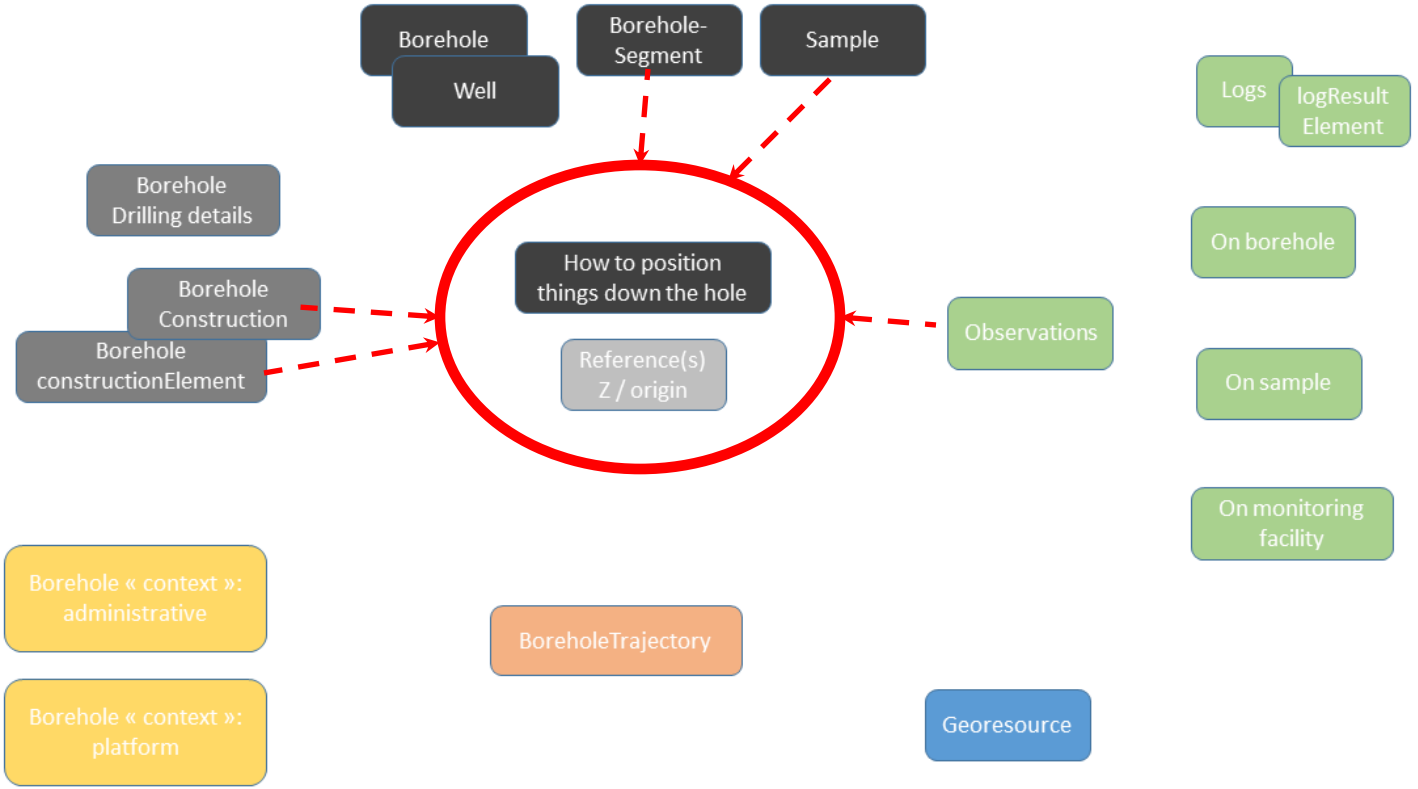
Vocabulary needs

- With a shared aspect



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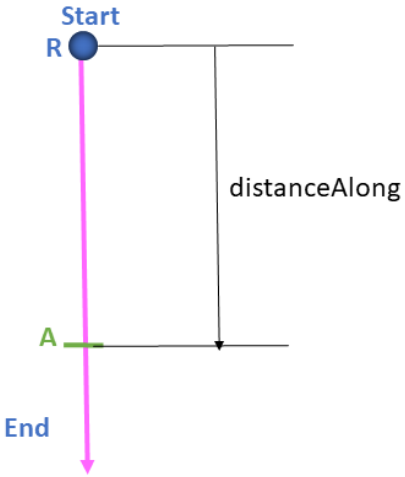
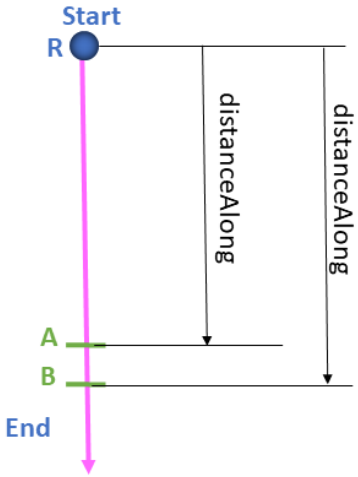
‘BhML Core’ - Explained

- Element located in the Borehole (observation, construction elements, sample, …) are positioned
  - At a location or from a location to another





BhML flavoured ISO 19148 figure 1 to 4 (vertically)

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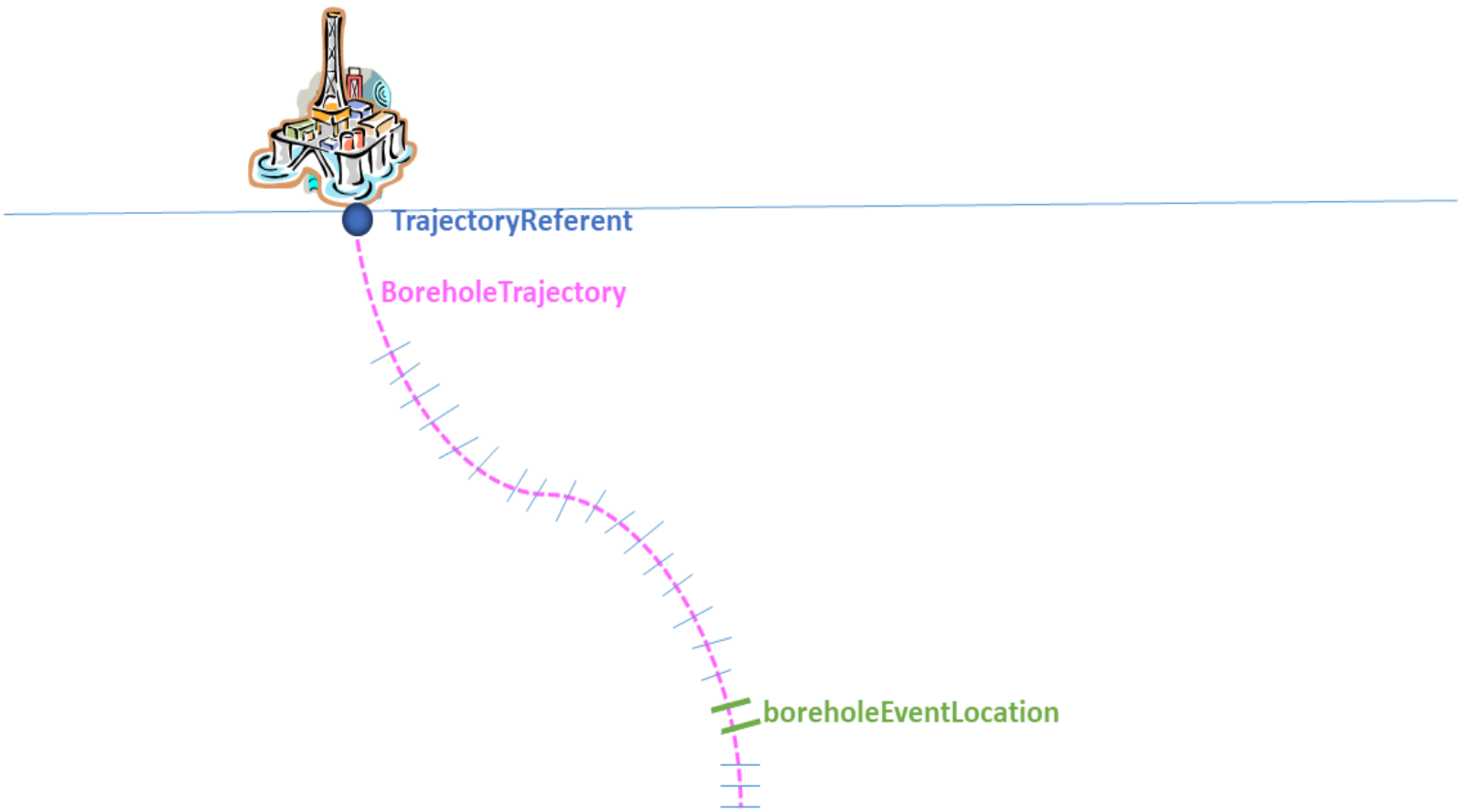
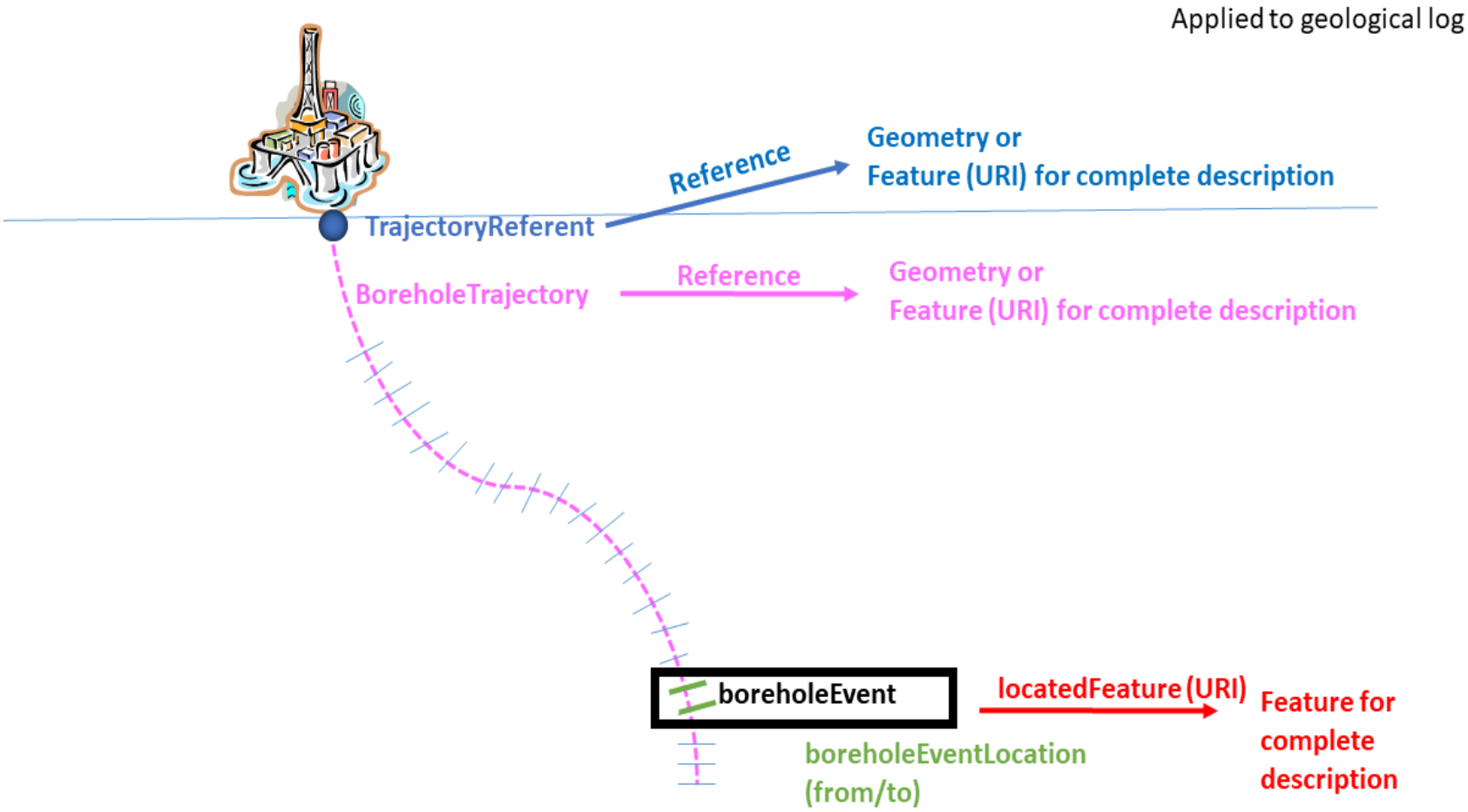
‘BhML Core’ - Explained

- BoreholeEvent = element located in the Borehole



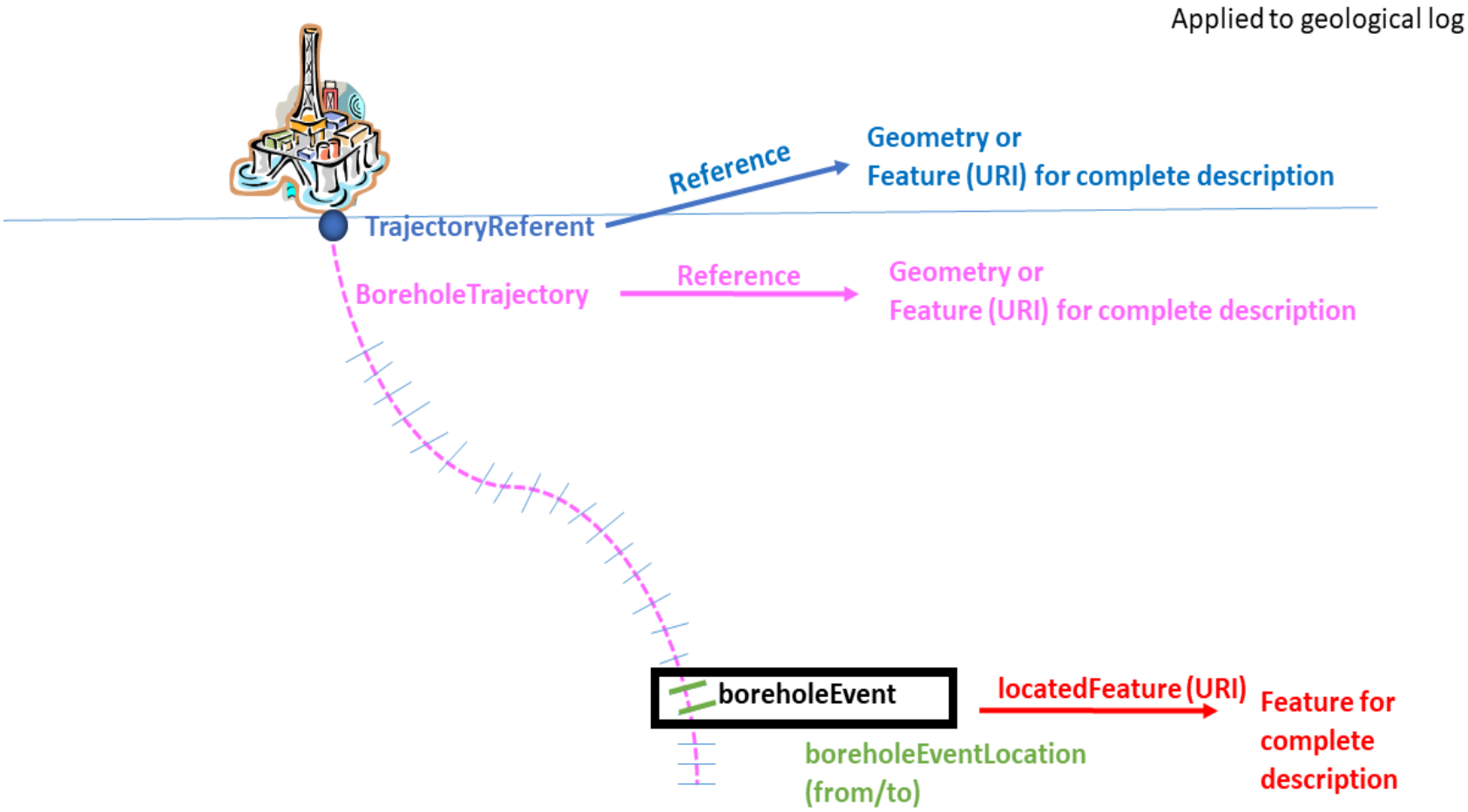
‘BhML Core’ - Explained

- BoreholeEvent provides both location and the locatedFeature



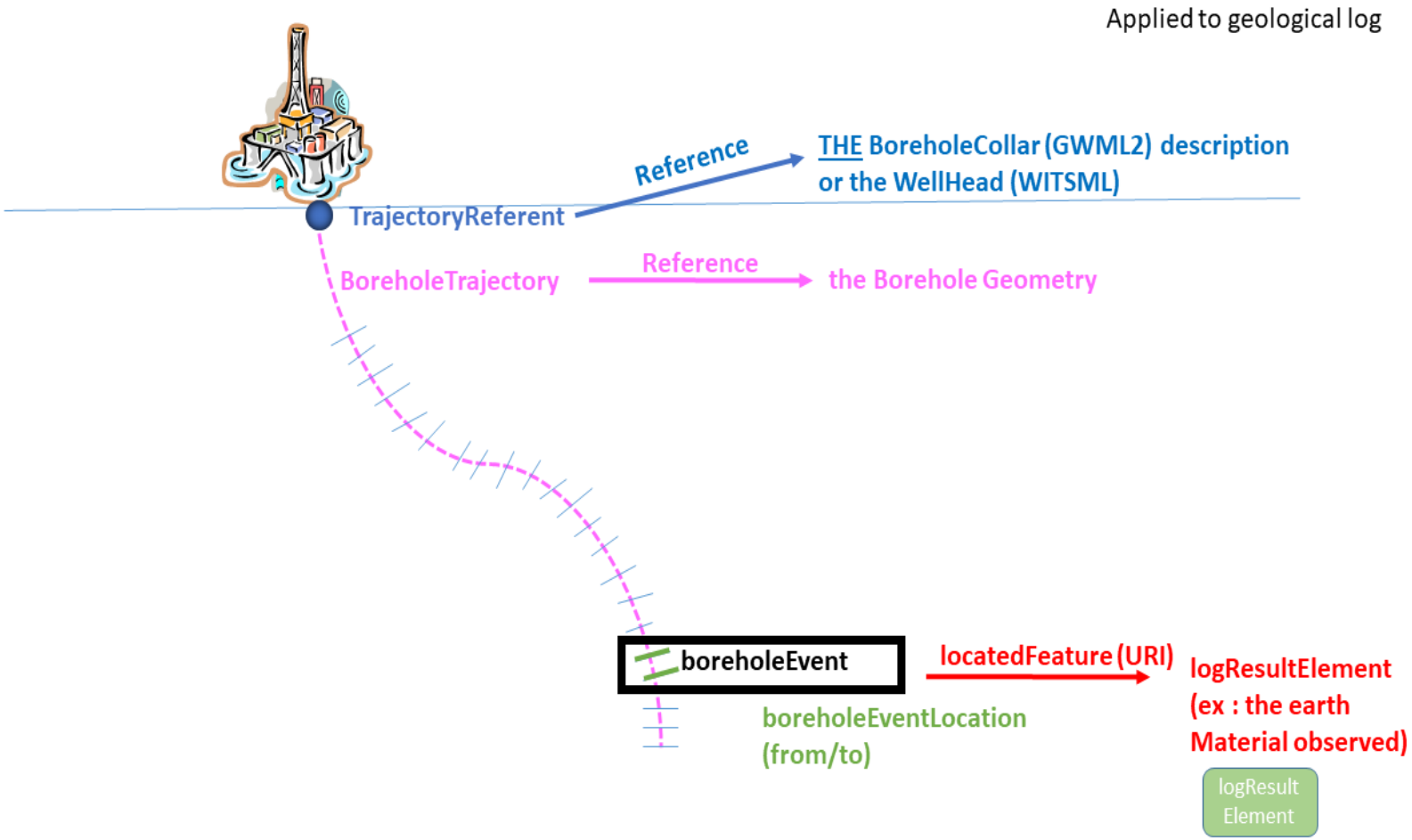
‘BhML Core’ - Explained

- Just geometry of full feature description



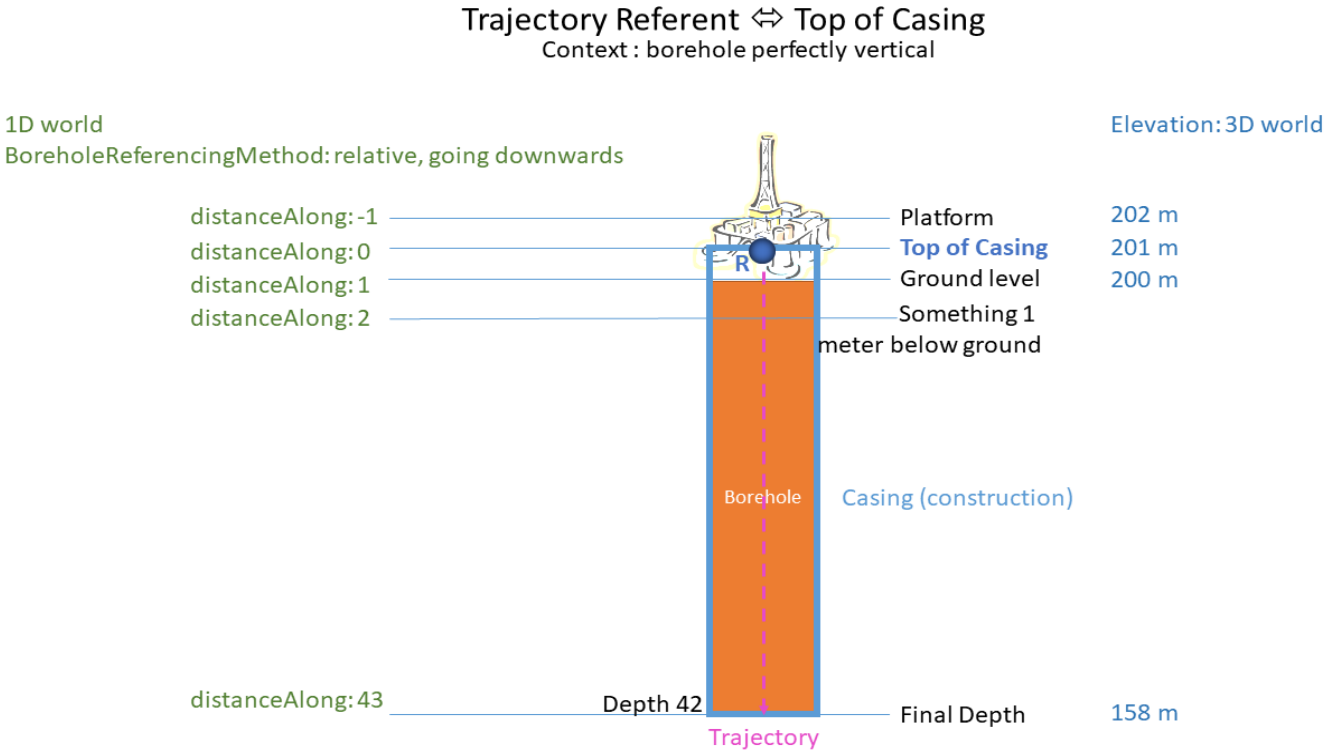
‘BhML Core’ - Explained

- The locatedFeature can come with it’s own semantics



‘BhML Core’ - Explained

- The TrajectoryReferent can be
  - located anywhere on the BoreholeTrajectory
  - any feature that is considered an observable reference to pin a known location
- The BoreholeReferencingMethod defines
  - whether distanceAlong is relative to the TrajectoryReferent or absolute
  - the orientation and the unit Of Measure



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‘BhML Core’ - Methodology

- These pattern come from ISO 19148 – linear referencing

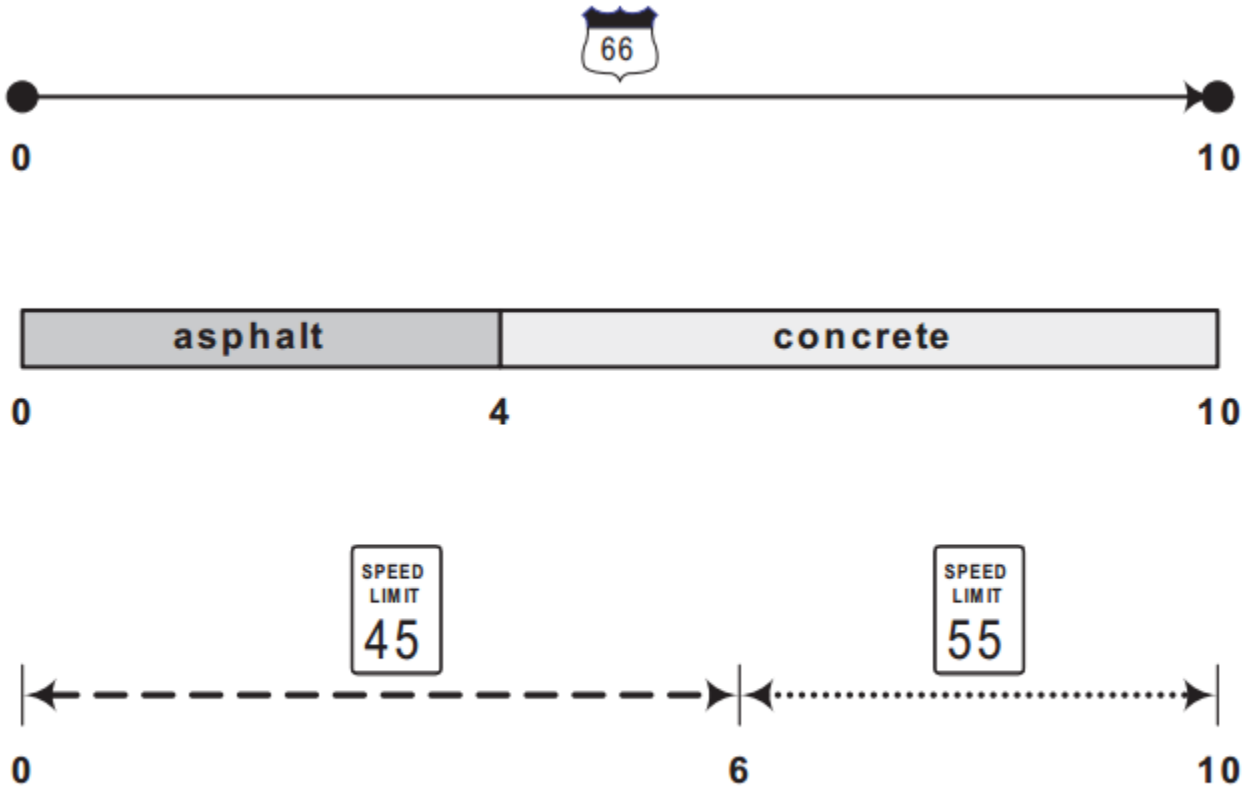

Figure D.3 — Segmentation example

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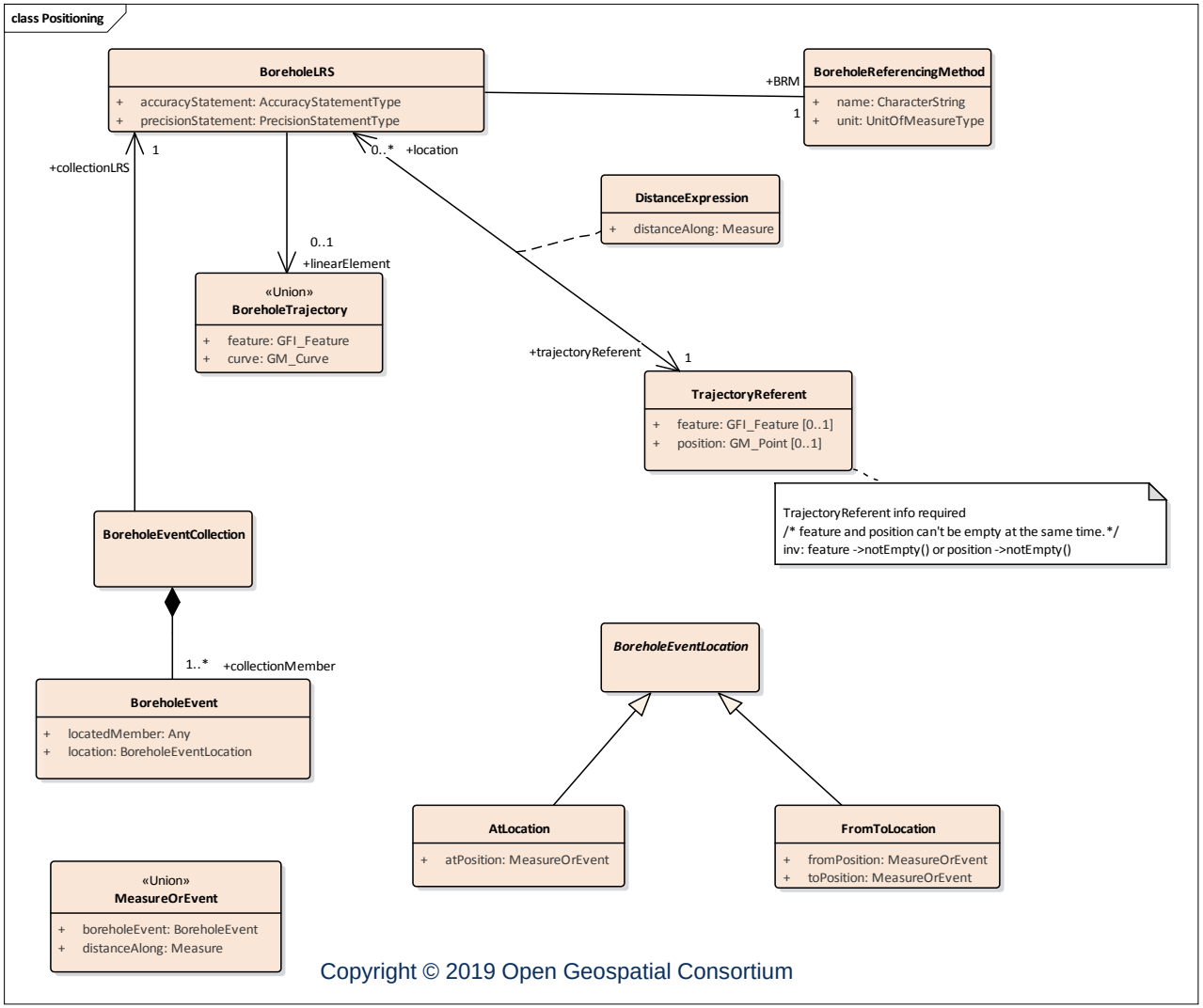
‘BhML Core’ - Methodology

- ‘BhML Core’ conceptual



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‘BhML Core’ - Methodology

- Element not reused from ISO 19148
  - Linear elements are limited to Feature and Curve. Directed edges are not used in any use cases.
  - Did not consider branching in borehole trajectory. They exist, but are easier to model as distinct trajectories (as different BoreholeEventCollection) that happen to partially overlap
  - ISO 19148 allows each Event to have their own Distance expression (and therefore, their own referent) and their own LinearReferencingMethod. In the context of a borehole, we normally use a single referent.
  - Removing LE_EventTime. Time dependant features reported along the trajectory are expected to be modelled as OM_Observation, which carry their own time properties.

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‘BhML Core’ - Methodology

- ‘BhML Core’ is introducing
  - a semantic closer to the Borehole domain,
  - restricting some ISO 19148 patterns (ex one Referent),
  - adding the possibility to position an ‘Event’ with regards to another Event,
  - allowing to link to standards that are not Features as modelled in ISO19109, hence widening to any types.

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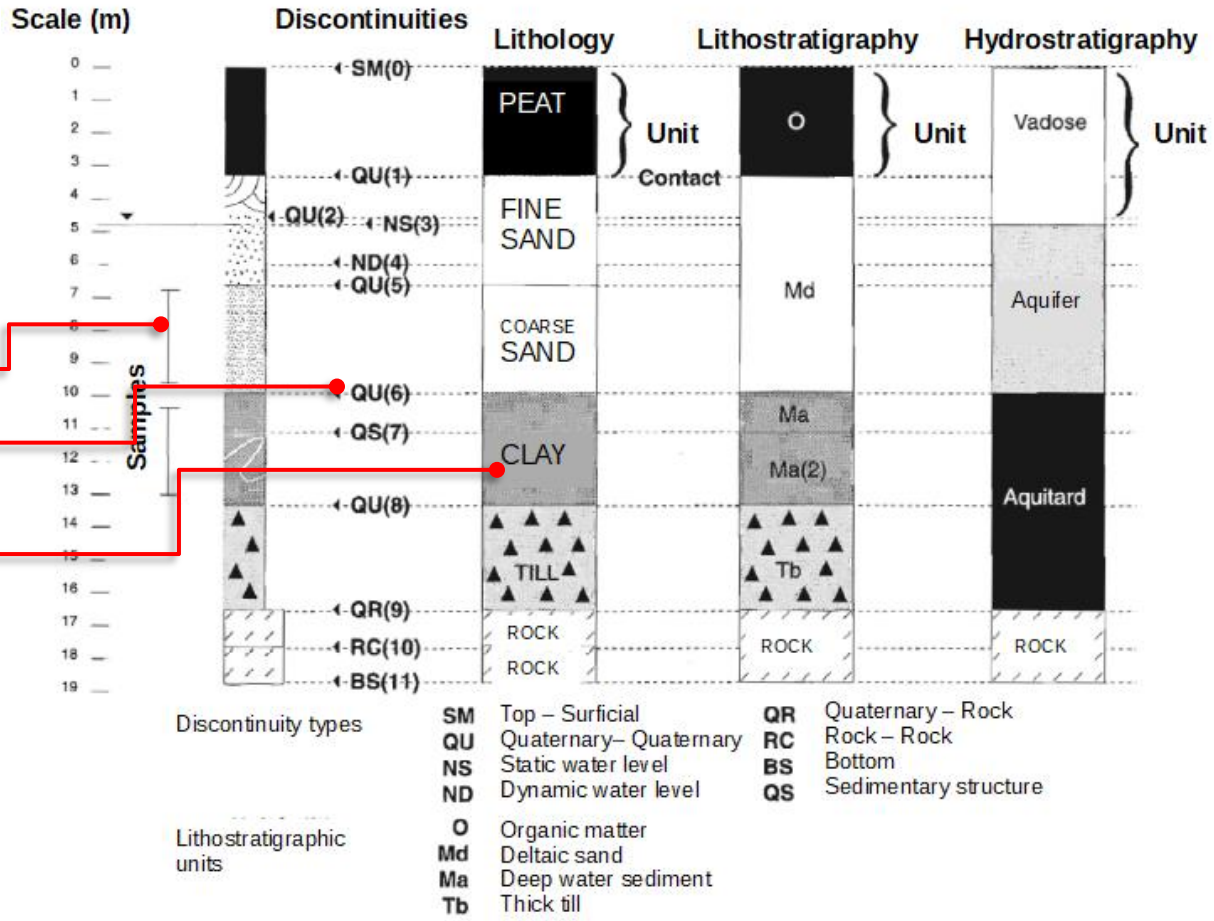
Testing

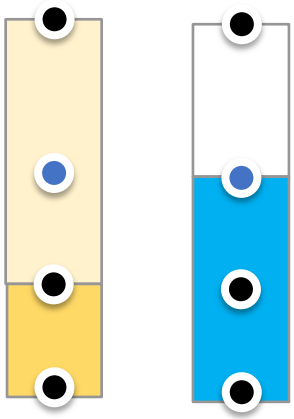
NRCan example

Borehole with many features located along its path and multiple interpretations

- **Samples**
- **Contacts or any other boundaries**
- **Units**

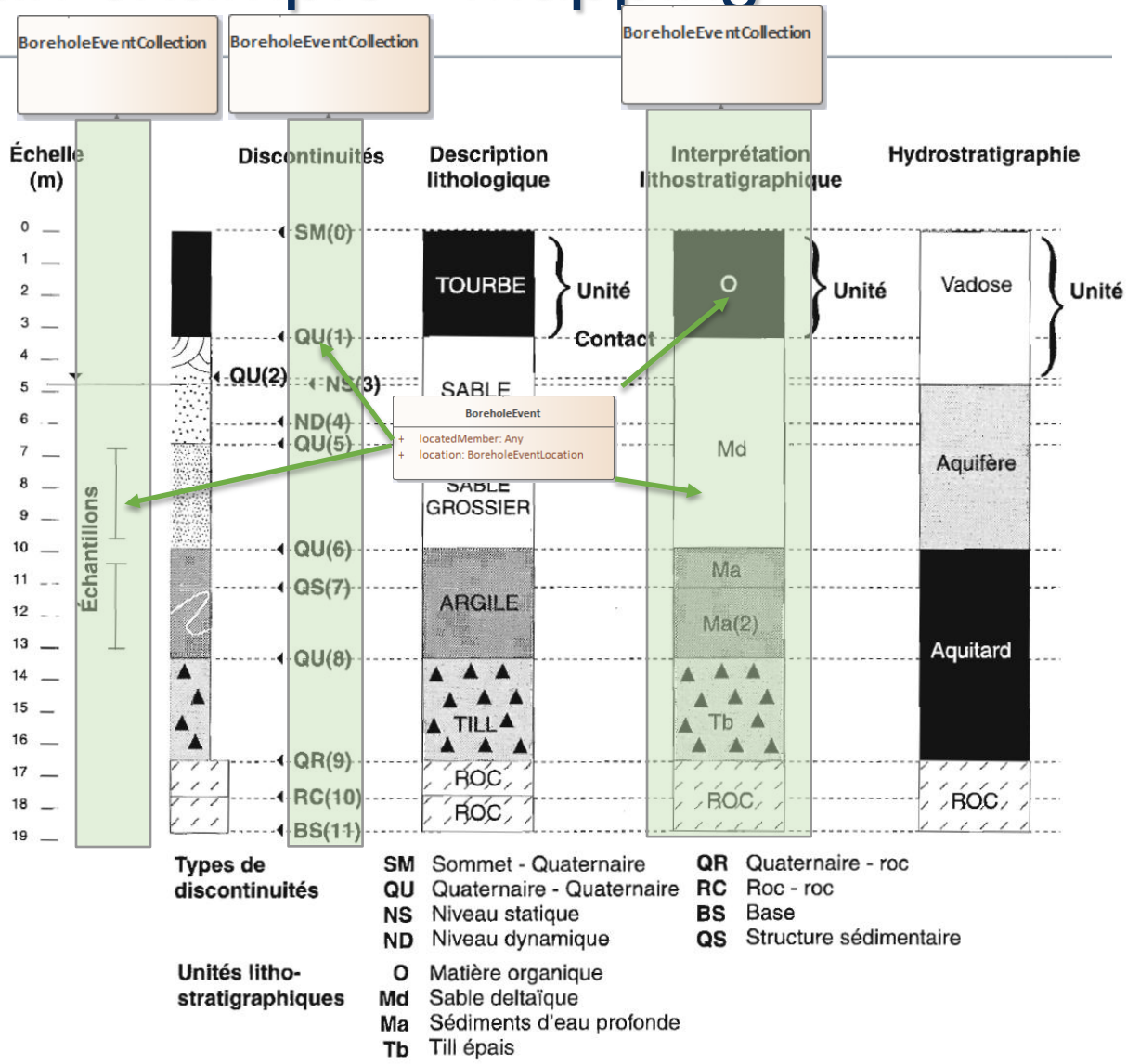


NRCan example - Mapping



Units delimited by boudaries (BoreholeEvents delimited by other BoreholeEvents)

Sample interval unconstrained by natural boundaries



(Version originale française.. Nous sommes en France après tout)

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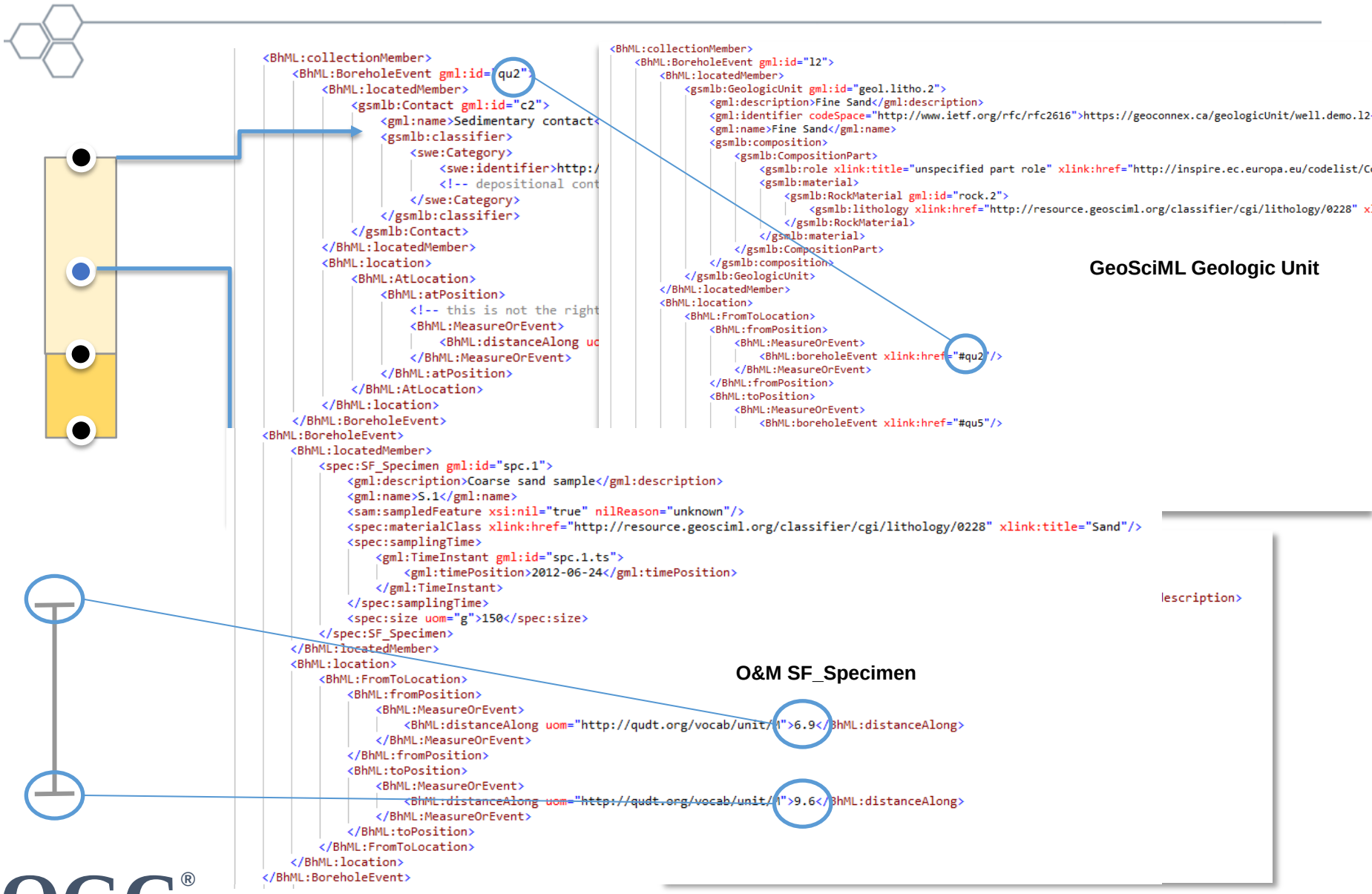
NRCan example – GML XML encoding



BML - BhML example

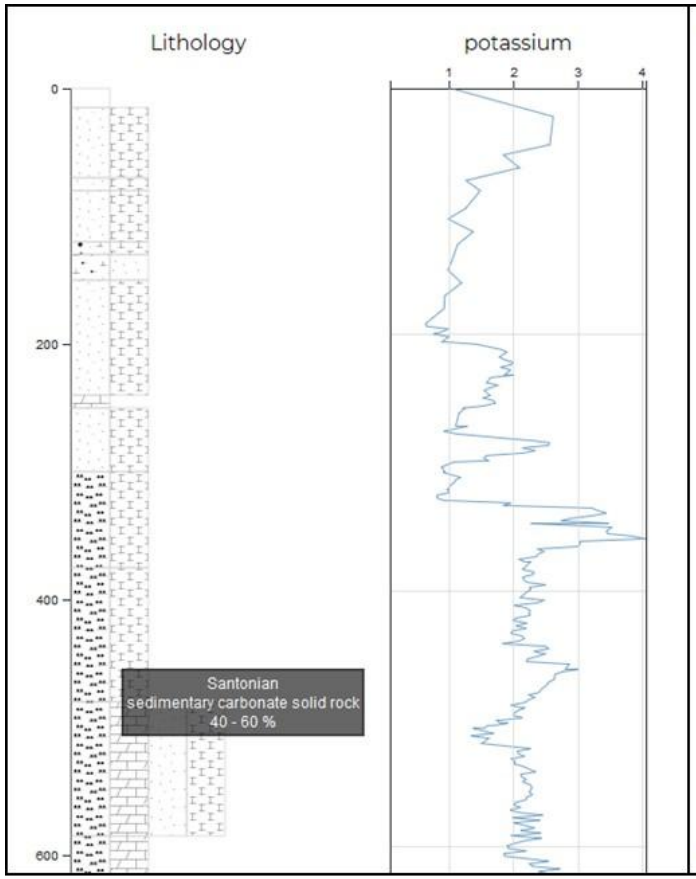
- Extending/Restricting
  BhML BoreholeEvent & locatedMember

```
<!– Substituting BhML:BoreholeEvent -->
<xs:element name="GroundwaterObservationEvent" type="bml:GroundwaterObservationEventType" substitutionGroup="BhML:BoreholeEvent"/>
<xs:complexType name="GroundwaterObservationEventType">
    <xs:complexContent>
        <xs:restriction base="BhML:BoreholeEventType">
            <xs:sequence>
                <xs:element ref="BhML:locatedMember"/>
                <xs:element ref="BhML:location"/>
            </xs:sequence>
        </xs:restriction>
    </xs:complexContent>
</xs:complexType>

<!– Specific (dependent) bml types restricting BhML:locatedMember
    by substituting bml:AbstractMeasurement -->
<xs:complexType name="LocatedGroundwaterObservationMemberType">
    <xs:complexContent>
        <xs:restriction base="BhML:LocatedMemberType">
            <xs:sequence>
                <xs:element ref="bml:GroundwaterObservation"/>
            </xs:sequence>
        </xs:restriction>
    </xs:complexContent>
</xs:complexType>

<!– Specific bml element GroundwaterObservation, referenced by BhML:locatedMember -->
<xs:element name="GroundwaterObservation" type="bml:GroundwaterObservationLogType" substitutionGroup="bml:AbstractMeasurement" nillable="true"/>

<xs:complexType name="GroundwaterObservationLogType"> ... </xs:complexType>
```

```
<element name="locatedMember" type="BhML:LocatedMemberType" abstract="false"/>

<complexType name="LocatedMemberType" abstract="false">
    <sequence minOccurs="0">
        <!-- implement dependency by deriving from bml base object AbstractMeasurement -->
        <!-- since bml:AbstractMeasurement substitutes gml:AbstractObject,
             files will be valid against original BhML schema -->
        <element ref="bml:AbstractMeasurement"/>
        <!--
        <element ref="gml:AbstractObject"/>
        -->
    </sequence>
</complexType>
```

BML - BhML example

- BhML Dependency:
  bml RockComponents & RockClassification




```
<BhML:collectionMember>
    <bml:RockClassificationEvent><!-- substituting BhML:BoreholeEventType -->
        <BhML:locatedMember>
            <bml:RockComponents><!-- substituting BhML:locatedMember/AbstractObject -->
                <bml:rockCode>MEZ; TMZ; GU; 3; FS; 2</bml:rockCode>
                <bml:rockNameText>Marlstone, Marl/Claystone</bml:rockNameText>
                <bml:petrography>
                    <bml:Lithology>
                        <bml:rockName codeSpace="RockNameList">fsc</bml:rockName>
                        <bml:percentageFromTo>40-60</bml:percentageFromTo>
                    </bml:Lithology>
                </bml:petrography>
                <bml:stratigraphy>
                    <bml:ChronoStratigraphy codeSpace="ChronoStratigraphy">K2S</bml:ChronoStratigraphy>
                </bml:stratigraphy>
            </bml:RockComponents>
        </BhML:locatedMember>
        <BhML:location>
            <BhML:FromToLocation>
                <BhML:fromPosition>
                    <BhML:MeasureOrEvent>
                        <BhML:distanceAlong uom="m">480</BhML:distanceAlong>
                    </BhML:MeasureOrEvent>
                </BhML:fromPosition>
                <BhML:toPosition> ... 585</BhML:toPosition>
            </BhML:FromToLocation>
        </BhML:location>
    </bml:RockClassificationEvent>
</BhML:collectionMember>
```

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BML - BhML example

- Making BML et. al. obsolete

```
<DataRecord definition="bml:Interval">
    <field name="BhML:locatedMember">
        <DataRecord definition=" bml:RockComponents">
            <field name="stratigraphy">
                <DataRecord definition="bml:Stratigraphy">
                    <field name="chronoStratigraphy">
                        <Text definition="http://www.infogeo.de/bml/ChronoStratigraphyList.xml">K2S </Text>
                    </field>
                </DataRecord>
            </field>
            <field name="petrography">
                <DataRecord definition="bml:Petrography">
                    <field name="lithology">
                        <DataRecord definition="bml:Lithology">
                            <field name="rockName">
                                <Text definition="http://www.infogeo.de/bml/RockNameList.xml"/>Marlstone, Marl/Claystone</Text>
                            </field>
                            <field name="percentage">
                                <Quantity definition="BoreholeMeasurements"> <value>42</value> </Quantity>
                            </field>
                        </DataRecord>
                    </field>
                </DataRecord>
            </field>
        </DataRecord>
    </field>
</DataRecord>
```

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BhML to ResqML Mapping

- Jean-François Rainaud, Geosiris, presentation

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Other testings

- EPOS COSC Sample & Segment
  - UU-SE sample and segment initially described using EPOS model
  - easily exposed according to ‘BhML Core’

- CeRDI at Federation University (FedUni)
  - To be able to use the BoreholeML information model to deliver the ‘Commercial’, ‘Environmental’ and ‘Scientific’ Use-Cases as defined in the GWML2 Engineering Report (OGC 15-082)

  - Manual transformation of the current CeRDI GWML2 ‘GW_Well’ and ‘Borehole’ features WFS GML responses to the BhML XML schema.

Findings

- It works
- BhML is a reusability pattern where a borehole is “domain agnostic” and allow existing communities to maintain their concepts and vocabulary
- The ISO-19148 flavoured conceptual model fits much of the positioning use cases with minor adaptation, mostly simplifications
- The delimitation between “positioning” concepts and domain specific concepts does not pose any major difficulties

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Impact on external standards

- OGC (GeoSciML and GWML)
  - GeoSciML and GWML SWG could publish standalone borehole extensions while both use the same BhML core package.
- Borehole ML
  - BML can be easily mapped to BhML
  - BhML providing a domain agnostic mechanism will help reduce redundancy in standards.
- RESQML
  - To gather BhML represented information on BoreHoles and use it for petroleum or infrastructure, environment and Building Industry it could be possible to automatize the conversion of BhML from and to RESQML entities

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Recommendations

- OGC supports the creation of a Borehole SWG to formalize the core borehole model as an official standard

- A Borehole SWG refines the model to reflect the nomenclature and concepts names used by the communities using Borehole

- A Borehole SWG reach to existing standard custodians to produce BhML compliant version of their existing borehole standards

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Recommendations

- The OGC GeoScience DWG may help in
  - Providing an umbrella that gathers geoscience data providers and consumers. Which may help assess the usability of the BhML standard
  - Induce the implementation of operational services based on geoscience data interoperability standards

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Thank you

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