QuakeML—An XML Representation of Seismological Data
Basic Event Description
Version 1.2

Recommendation
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Abstract

This document describes the standards for QuakeML, a data model and XML-based data exchange format for seismology. It presents UML class diagrams for two variants of seismic event parameter description, QuakeML BED and QuakeML BED-RT, and explains the components used (BED: basic event description). XML Schema and Relax NG representations of the data models are given.

QuakeML has been adopted as a standard for basic earthquake event description by the International Federation of Digital Seismograph Networks (FDSN, www.fdsn.org) in June 2011.

Acknowledgements

Contents

1. Introduction

Seismological data cover a broad range of information and are stored and exchanged in many different formats. In most cases, these format definitions are tailored to fit the specific requirements for a narrow field of applications. QuakeML, an XML representation of seismological data, is intended to standardize seismological data exchange, and to be applicable for a wide range of scientific and technical problems in seismology.

XML is a standardized general-purpose markup language that allows the formal definition of descriptive languages for a broad range of applications (Bray et al. 2000). One of its strengths is that it is plain-text based. Thus, it is platform-independent, readable by humans and machines, and probably reasonably future-proof regarding technological advancement. As a second advantage, because of its intrinsic extensibility XML-based languages can easily accommodate information gathered from multiple sources that provide different levels of completeness.

A basic outline of the general concept of QuakeML can be found in Schorlemmer et al. (2004)[1]. QuakeML has a modular design. There is an umbrella schema which defines the root element. First-level child elements are defined in separate packages which cover a specific thematic aspect. Their schema definitions are imported from the umbrella schema. This document defines the standard for the QuakeML package *Basic Event Description* (BED). The package provides a basic description of seismic event data and introduces a concept for unambiguous resource identification. It includes information on origin, origin uncertainties, picks, amplitudes, magnitudes and focal mechanisms. The BED package needs to be complemented with subsequent standard documents on seismic inventory, and resource metadata. Work on these is under way. Possible future QuakeML package development could be on macroseismology, slip distributions, and ground motion information.

QuakeML BED describes properties of seismic events in a hierarchical manner, using *a posteriori* knowledge of the relations between elements (e.g., association of origins to events). When dealing with real-time processing of seismic data, this information may not be present. Therefore, an alternative version of BED using flatter hierarchies has been defined (BED-RT).

While the hierarchical (non-RT) model is a straightforward solution for the description of earthquake catalogs, i.e., for situations with known event identities, the RT model is suitable in the real-time context of seismic observatories. Here, it might be the case that only unassociated picks are collected, or preliminary origins are computed before a final event identity is assigned. Another potential usage of the RT version is with international agencies that collect data from many contributors with potentially conflicting opinions on how to separate the observed shaking into individual events.

While developing QuakeML we have kept an eye on similar concepts contained in existing applications like Earthworm[2] and CSS 3.0. For the part dealing with resource identifiers and metadata we have taken inspiration from development undertaken in the astrophysical *Virtual Observatory* community[3].

Major new features that have been introduced in QuakeML version 1.2 are: (i) the modular design; and (ii) extension points in the schema. There are also a few changes to the content, most notably in the *Amplitude* class. The predecessor version 1.1 was based on the outcome of a public *Request for Comments* (RFC) process that was conducted from December 2007 until November 2008. A documentation of the RFC can be found on the project web page[4].

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[1]Note, however, that the XML format definition given therein is outdated and is superseded by this document.
[2]http://folkworm.ceri.memphis.edu/ew-doc/
[3]http://www.ivoa.net
[4]http://www.quakeml.org/RFC_BED_1.0

2. QuakeML Data Model

2.1. UML Class Diagrams

The QuakeML data model has been expressed in a UML[5] formulation which serves as a basis for further representations, like XML Schema[6] (XSD), Relax NG[7] (RNG) or SQL database schema. Figs. 1, 2, and 3 show the UML class diagrams for the two flavours of QuakeML-BED. Fig. 1 represents the standard (hierarchical) BED variant, while Fig. 2 shows the modified variant for real-time processing (BED-RT). Types and enumerations that are used in both variants are shown separately in Fig. 3.

In the class diagrams, only two types of relations have been used in order to allow easy transformation to other schemas and for easy automated code generation. "Has-a" relationships are represented by UML compositions and are mapped to parent-child relations in XML. Associations are used to indicate less tight relations between objects.

UML elements that are present in both QuakeML-BED flavours are *EventParameters*, *Event*, *Origin*, *OriginUncertainty*, *Arrival*, *Pick*, *Amplitude*, *Magnitude*, *StationMagnitude*, *StationMagnitudeContribution*, *FocalMechanism*, and *MomentTensor*.

BED-RT additionally has the element *Reading*.

In the hierarchical model, the class *EventParameters* is made up of *Event* objects and represents an earthquake catalog or a seismic bulletin. *Event* is connected via composition to *Origin*, *Magnitude*, *StationMagnitude*, *FocalMechanism*, *Amplitude*, and *Pick*, which all describe properties of a specific seismic event.

In BED-RT *EventParameters* can additionally hold objects of type *Origin*, *Amplitude*, *Pick*, *Reading*, *Magnitude*, *StationMagnitude*, and *FocalMechanism*. These are hierarchically on the same level as *Event* and can be connected to specific events via references inside the *Event* element. BED-RT has objects of type *Reading*. These are used to group *Amplitude* and *Pick* objects that are known to belong to the same event, but the event itself is unknown.

In both variants, *Arrival* is linked to *Origin* by composition. Thus, arrivals cannot exist independently from origins. An origin can have several arrivals, but is not required to have any. The connection between *Pick* and *Arrival* is quite weak which is expressed by an association. A pick can be related to several arrivals, i. e., concurrent different interpretations of the same amplitude anomaly in a seismogram may exist. *Amplitude* and *StationMagnitude* as well as *Amplitude* and *Pick* are relatively loosely coupled, as expressed by an association. *Magnitude* describes the "network" magnitude that has been derived from several station magnitudes. It is related to *StationMagnitude* via the class *StationMagnitudeContribution* and is connected to *Origin* by association. *StationMagnitude* is connected to *Origin* by association.

A detailed description of the complex types, enumerations, and elements used in the UML class diagrams can be found in Sect. 3.

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[5]The *Unified Modeling Language* is a general-purpose modeling language that is developed under the auspices of the *Object Management Group* (http://www.omg.org).

[6]http://www.w3.org/TR/xmlschema-1/, http://www.w3.org/TR/xmlschema-2/

[7]http://www.relaxng.org
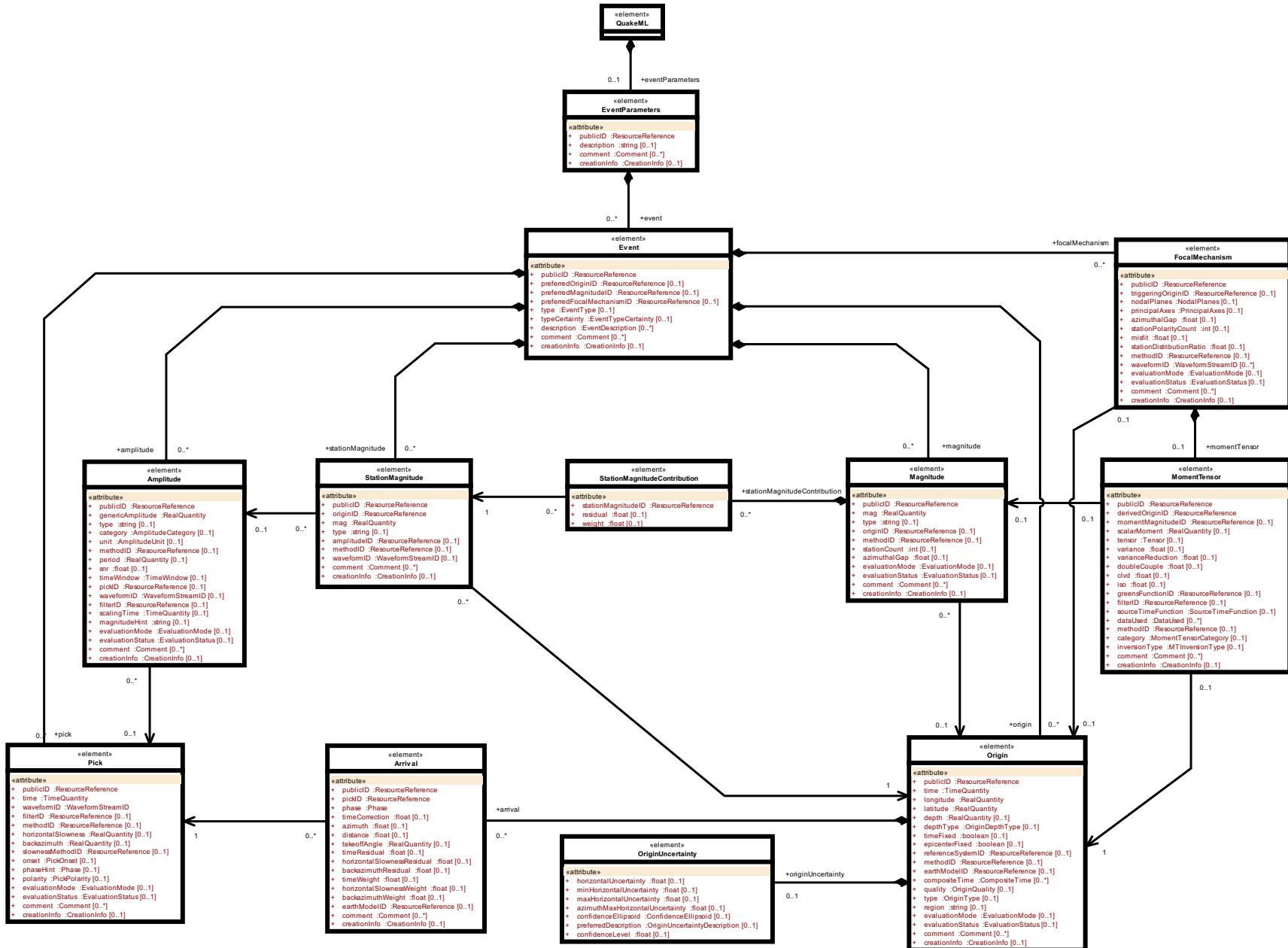
Figure 1: UML class diagram of the QuakeML BED data model. Two different types of relations between classes are used: (i) compositions, marked by lines with filled diamonds; and (ii) associations, marked by arrows. Compositions indicate a stronger coupling between two classes than associations.
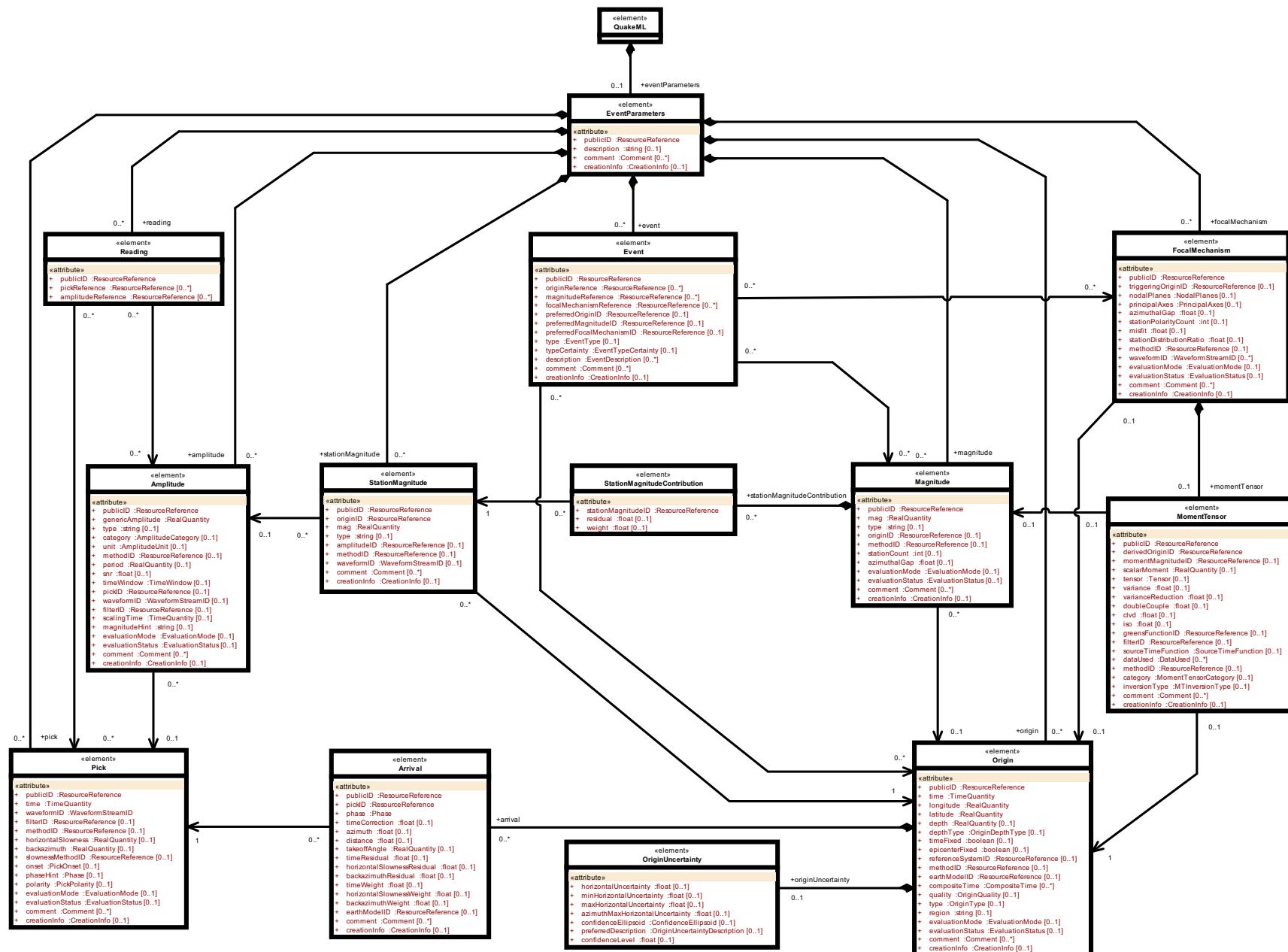
Figure 2: UML class diagram of the QuakeML BED-RT (real-time processing) data model.

«type» TimeQuantity

«attribute»
+ value :datetime
+ uncertainty :float [0..1]
+ lowerUncertainty :float [0..1]
+ upperUncertainty :float [0..1]
+ confidenceLevel :float [0..1]

«type» CompositeTime

«attribute»
+ year :IntegerQuantity [0..1]
+ month :IntegerQuantity [0..1]
+ day :IntegerQuantity [0..1]
+ hour :IntegerQuantity [0..1]
+ minute :IntegerQuantity [0..1]
+ second :RealQuantity [0..1]

«type» RealQuantity

«attribute»
+ value :float
+ uncertainty :float [0..1]
+ lowerUncertainty :float [0..1]
+ upperUncertainty :float [0..1]
+ confidenceLevel :float [0..1]

«type» IntegerQuantity

«attribute»
+ value :int
+ uncertainty :int [0..1]
+ lowerUncertainty :int [0..1]
+ upperUncertainty :int [0..1]
+ confidenceLevel :float [0..1]

«type» Axis

«attribute»
+ azimuth :RealQuantity
+ plunge :RealQuantity
+ length :RealQuantity

«type» NodalPlane

«attribute»
+ strike :RealQuantity
+ dip :RealQuantity
+ rake :RealQuantity

«type» PrincipalAxes

«attribute»
+ tAxis :Axis
+ pAxis :Axis
+ nAxis :Axis [0..1]

«type» NodalPlanes

«attribute»
+ nodalPlane1 :NodalPlane [0..1]
+ nodalPlane2 :NodalPlane [0..1]
+ preferredPlane :int [0..1]

«type» WaveformStreamID

«attribute»
+ networkCode :string
+ stationCode :string
+ channelCode :string [0..1]
+ locationCode :string [0..1]
+ resourceURI :ResourceReference [0..1]

«enumeration» EventType

NOT_EXISTING = not existing
NOT_REPORTED = not reported
EARTHQUAKE = earthquake
ANTHROPOGENIC_EVENT = anthropogenic event
COLLAPSE = collapse
CAVITY_COLLAPSE = cavity collapse
MINE_COLLAPSE = mine collapse
BUILDING_COLLAPSE = building collapse
EXPLOSION = explosion
ACCIDENTAL_EXPLOSION = accidental explosion
CHEMICAL_EXPLOSION = chemical explosion
CONTROLLED_EXPLOSION = controlled explosion
EXPERIMENTAL_EXPLOSION = experimental ex...
INDUSTRIAL_EXPLOSION = industrial explosion
MINING_EXPLOSION = mining explosion
QUARRY_BLAST = quarry blast
ROAD_CUT = road cut
BLASTING_LEVEE = blasting levee
NUCLEAR_EXPLOSION = nuclear explosion
INDUCED_OR_TRIGGERED_EVENT = induced or trig...
ROCK_BURST = rock burst
RESERVOIR_LOADING = reservoir loading
FLUID_INJECTION = fluid injection
FLUID_EXTRACTION = fluid extraction
CRASH = crash
PLANE_CRASH = plane crash
TRAIN_CRASH = train crash
BOAT_CRASH = boat crash
OTHER_EVENT = other event
ATMOSPHERIC_EVENT = atmospheric event
SONIC_BOOM = sonic boom
SONIC_BLAST = sonic blast
ACOUSTIC_NOISE = acoustic noise
THUNDER = thunder
AVALANCHE = avalanche
SNOW_AVALANCHE = snow avalanche
DEBRIS_AVALANCHE = debris avalanche
HYDROACOUSTIC_EVENT = hydroacoustic event
ICE_QUAKE = ice quake
SLIDE = slide
LANDSLIDE = landslide
ROCKSLIDE = rockslide
METEORITE = meteorite
VOLCANIC_ERUPTION = volcanic eruption

«type» CreationInfo

«attribute»
+ agencyID :string [0..1]
+ agencyURI :ResourceReference [0..1]
+ author :string [0..1]
+ authorURI :ResourceReference [0..1]
+ creationTime :datetime [0..1]
+ version :string [0..1]

«type» ConfidenceEllipsoid

«attribute»
+ semiMajorAxisLength :float
+ semiMinorAxisLength :float
+ semiIntermediateAxisLength :float
+ majorAxisPlunge :float
+ majorAxisAzimuth :float
+ majorAxisRotation :float

«type» Tensor

«attribute»
+ Mrr :RealQuantity
+ Mtt :RealQuantity
+ Mpp :RealQuantity
+ Mrt :RealQuantity
+ Mrp :RealQuantity
+ Mtp :RealQuantity

«type» TimeWindow

«attribute»
+ begin :float
+ end :float
+ reference :datetime

«type» EventDescription

«attribute»
+ text :string
+ type :EventDescriptionType [0..1]

«type» OriginQuality

«attribute»
+ associatedPhaseCount :int [0..1]
+ usedPhaseCount :int [0..1]
+ associatedStationCount :int [0..1]
+ usedStationCount :int [0..1]
+ depthPhaseCount :int [0..1]
+ standardError :float [0..1]
+ azimuthalGap :float [0..1]
+ secondaryAzimuthalGap :float [0..1]
+ groundTruthLevel :string [0..1]
+ maximumDistance :float [0..1]
+ minimumDistance :float [0..1]
+ medianDistance :float [0..1]

«type» SourceTimeFunction

«attribute»
+ type :SourceTimeFunctionType
+ duration :float
+ riseTime :float [0..1]
+ decayTime :float [0..1]

«enumeration» EvaluationStatus

PRELIMINARY = preliminary
CONFIRMED = confirmed
REVIEWED = reviewed
FINAL = final
REJECTED = rejected

«type» DataUsed

«attribute»
+ waveType :DataUsedWaveType
+ stationCount :int [0..1]
+ componentCount :int [0..1]
+ shortestPeriod :float [0..1]
+ longestPeriod :float [0..1]

«type» Comment

«attribute»
+ text :string
+ id :ResourceReference [0..1]
+ creationInfo :CreationInfo [0..1]

«type» ResourceReference

«attribute»
+ resourceID :string

«type» Phase

«attribute»
+ code :string

«enumeration» EventDescriptionType

FELT_REPORT = felt report
FLINN_ENGDAHL_REGION = Flinn-Engdahl region
LOCAL_TIME = local time
TECTONIC_SUMMARY = tectonic summary
NEAREST_CITIES = nearest cities
EARTHQUAKE_NAME = earthquake name
REGION_NAME = region name

«enumeration» DataUsedWaveType

P_WAVES = P waves
BODY_WAVES = body waves
SURFACE_WAVES = surface waves
MANTLE_WAVES = mantle waves
COMBINED = combined
UNKNOWN = unknown

«enumeration» MomentTensorCategory

TELESEISMIC = teleseismic
REGIONAL = regional

«enumeration» EvaluationMode

MANUAL = manual
AUTOMATIC = automatic

«enumeration» PickOnset

EMERGENT = emergent
IMPULSIVE = impulsive
QUESTIONABLE = questionable

«enumeration» AmplitudeUnit

M = m
S = s
M/S = m/s
M/(S*S) = m/(s*s)
M*S = m*s
DIMENSIONLESS = dimensionless
OTHER = other

«enumeration» EventTypeCertainty

KNOWN = known
SUSPECTED = suspected

«enumeration» PickPolarity

POSITIVE = positive
NEGATIVE = negative
UNDECIDABLE = undecidable

«enumeration» OriginType

HYPOCENTER = hypocenter
CENTROID = centroid
AMPLITUDE = amplitude
MACROSEISMIC = macroseismic
RUPTURE_START = rupture start
RUPTURE_END = rupture end

«enumeration» AmplitudeCategory

POINT = point
MEAN = mean
DURATION = duration
PERIOD = period
INTEGRAL = integral
OTHER = other

«enumeration» SourceTimeFunctionType

BOX_CAR = box car
TRIANGLE = triangle
TRAPEZOID = trapezoid
UNKNOWN = unknown

«enumeration» MTInversionType

GENERAL = general
ZERO_TRACE = zero trace
DOUBLE_COUPLE = double couple

«enumeration» OriginUncertaintyDescription

HORIZONTAL = horizontal unce...
ELLIPSE = uncertainty ellipse
ELLIPSOID = confidence ellipsoid

«enumeration» OriginDepthType

FROM_LOCATION = from location
FROM_MOMENT_TENSOR_INVERSION = from moment ten...
BROAD_BAND_P_WAVEFORMS = from modeling o...
CONSTRAINED_BY_DEPTH_PHASES = constrained by ...
CONSTRAINED_BY_DIRECT_PHASES = constrained by ...
CONSTRAINED_BY_DEPTH_AND_DIRECT_PHASES = constrained by ...
OPERATOR_ASSIGNED = operator assigned
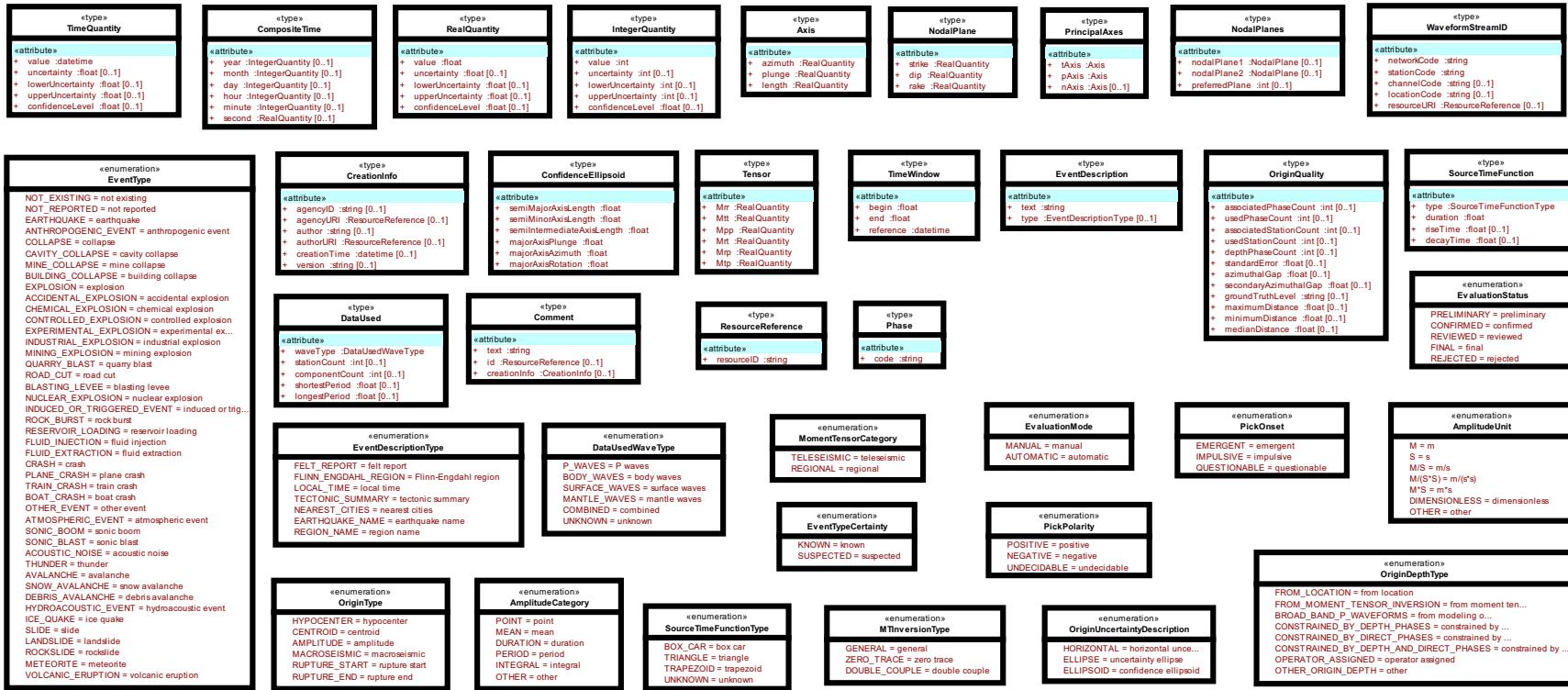OTHER_ORIGIN_DEPTH = other

Figure 3: UML class diagram of types and enumerations used in the QuakeML BED class diagrams (Figs. 1 and 2).

3. XML Serialization

In this Section, we provide a detailed description of the classes and of the complex types used in the QuakeML data model (see the UML class diagrams in Figs. 1, 2, and 3). For each class and for each complex type, a table with its UML attributes is shown. This table lists the attribute name, UML type, and multiplicity as also shown in the UML class diagrams. For UML attributes that have an XML representation of SimpleType, this type is indicated in the fourth column (XML type). The last column of the tables describing the class attributes lists the XML representation of UML attributes which are of SimpleType. Their XML representation can be either Element, Attribute, or CDATA. This information is contained as tagged values in the UML model and is used by an automated code generator when creating the XML Schema description for QuakeML from the XMI[8] representation of the UML model. Note that UML attributes of XML ComplexType are always represented as XML child elements. Several class instances can have further child elements through UML composition. If this is the case, a corresponding table is shown that lists attribute name, UML type, and multiplicity. The columns XML type and representation are obsolete then. Note that child element names begin with a lowercase letter, as can be seen in the class diagrams from the UML role names plotted next to the UML composition arrow connectors. In Sect. 3.5 XML format examples are given at the end of each class description.

3.1. Resource Identifiers

In a global network of seismological resources there is a need for a mechanism which allows to unambiguously identify resources. In this context, resources can be of vastly different character, e. g., institutions, working groups, seismic stations, technical equipment, but also algorithms, computer codes or published papers. We propose a naming scheme for resource identifiers which adopts the format of *Uniform Resource Identifiers* (URIs, Berners-Lee et al. 1998). Identifiers take the generic form of

[smi|quakeml]:⟨authority-id⟩/⟨resource-id⟩[#⟨local-id⟩]

They consist of an authority identifier, a unique resource identifier, and an optional local identifier. The URI schema name smi stands for *seismological meta-information*, thus indicating a connection to a set of metadata associated with the resource.

The XML Schema definition of QuakeML resource identifiers is as follows:

```
<xs:simpleType name="ResourceIdentifier">
  <xs:restriction base="xs:anyURI">
    <xs:pattern value="(smi|quakeml):[\w\d][\w\d\-\.\*\(\)_~']{2,}/[\w\d\-\.\*\(\)_
        ~'][\w\d\-\.\*\(\)\+\?_~'=,;#/&amp;]*"/>
  </xs:restriction>
</xs:simpleType>
```

The authority-id part must consist of at least three characters, of which the first character has to be alphanumeric. The subsequent characters can be alphanumeric or from the following list: -, _, ., ~, *, ', (,). After the authority-id, a forward slash ("/") must follow which separates the authority-id from the resource-id. The resource-id must contain at least one character, which can be either alphanumeric, or from the eight special characters which are allowed for the authority-id. For the remaining characters of the resource-id, also the comma (",") and semicolon (";") characters and characters from the following list can be used: +, ?, =, #, /, &. Note that the forward slash which separates authority-id and resource-id is always the first forward slash in the resource identifier. The resource-id may be followed by a stop character ("#") and a local identifier which can be made up of alphanumeric characters, the comma (",") and semicolon (";") characters, and the characters from the following list: -, _, ., ~, *, ', (,), /, +, =, ?. Local identifiers are thought to denote resources that have no own metadata description associated, but are part of a larger collection for which such metadata exists.

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[8]XML Metadata Interchange (XMI) is an XML-based standard for the exchange of metadata information (http://www.omg.org/technology/documents/formal/xmi.htm).

The URI schema name prefix is not strictly a part of the resource identifier. Other URI schema names can be used with the identifier in order to retrieve other kinds of information associated with the resource, e.g., quakeml for resources that have a QuakeML representation. For the description of resources which are not officially controlled by an authority, local identifiers can be assigned using the keyword "local" as authority-id. Resource identifiers are intended to be resolved by registries, i.e., institutions acting as registries will provide web services that will return a metadata description of a resource if queried with a resource identifier as a parameter.

The naming authority and registry system is intended to be distributed and de-centralized, i.e., there is no single central registry acting as naming authority. Instead of that, agencies can issue their own identifiers given that (i) the identifiers issued within their domain are unique; and (ii) the agencies provide services for resolving the issued identifiers into metadata. As a recommendation, authority identifiers should be built similar to existing web URLs, but *in reversed order*, so that the distinction between URLs (that relate directly to web content) and URIs (that are just identifiers) becomes apparent. A recommended scheme for authority IDs is

⟨top-level domain⟩.⟨organisation/institution⟩[.⟨sub-unit of organisation⟩]

Note that the last part is optional. Example authority IDs that are already actively used in the respective institutions are *ch.ethz.sed* for the Swiss Seismological Service at ETH Zurich, and *eu.emsc* for the European Mediterranean Seismological Centre.

The metadata description referenced by resource identifiers will be largely based on the Dublin Core vocabulary (Dublin Core Metadata Initiative 2003) and will provide information on the resource's identity, curation, general, collection and service content, and data quality. In particular, the metadata contain information on how to retrieve the resource, e.g., a URL pointer to an electronic document, or a Web Service description. This mechanism is particularly useful for resources that have a QuakeML representation. In that case, a resource identifier that is used in an extensive QuakeML file can be interpreted as a short cut for a QuakeML chunk that has been left out for conciseness.

The main purpose of the registry mechanism will be the resolution of identifiers which allows subsequent data retrieval in the way outlined above. Beyond this basic functionality, we envision future application of registries as the key infrastructure components for resource discovery. High-quality metadata collections are essential for advanced search services which can be used both by humans and intelligent information retrieval agents.

Resource identifiers in the UML formulation of QuakeML are of UML type *ResourceReference*. This type has an attribute **resourceID** which holds the identifier and is of the XSD type *ResourceIdentifer* given above. In the following sections the abbreviation *RI* is used to denote QuakeML resource identifiers.

3.2. Units and Conventions

3.2.1. SI Units

QuakeML generally uses the International System of Units[9] (SI). SI units used in QuakeML are meter (m), second (s), and newton (N). As the only exception, plane angles are not measured in radians, but in degrees (deg).

3.2.2. Coordinated Universal Time

Time information in QuakeML is generally given in Coordinated Universal Time (UTC). The representation is according to ISO 8601[10]. While ISO 8601 includes a time zone designator in order to account for non-UTC time, in QuakeML the allowed values are restricted to *Z*, *+00:00*, and *−00:00*. Omission of the time zone designator is allowed and is interpreted as UTC.

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[9]http://www.bipm.org/en/si/
[10]http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40874

3.3. Complex Types

3.3.1. ResourceReference

This type is used to refer to QuakeML resources as described in Sect. 3.1. The attribute **resourceID** contains the identifier that acts as a reference to the resource.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
resourceID	*string*	1	*RI*	CDATA

Description of Attributes

resourceID String that is used as a reference to a QuakeML resource. It must adhere to the format specifications given in Sect. 3.1. The string has a maximum length of 255 characters.

3.3.2. IntegerQuantity/RealQuantity

Physical quantities that can be expressed numerically—either as integers or as floating point numbers—are represented by their measured or computed values and optional values for symmetric or upper and lower uncertainties. The interpretation of these uncertainties is not defined in the standard. They can contain statistically well-defined error measures, but the mechanism can also be used to simply describe a possible value range. If the confidence level of the uncertainty is known, it can be listed in the optional attribute **confidenceLevel**. Note that **uncertainty**, **upperUncertainty**, and **lowerUncertainty** are given as absolute values of the deviation from the main **value** (see XML example below).

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
value	*int/float*	1	*xs:integer/xs:double*	Element
uncertainty	*int/float*	0..1	*xs:integer/xs:double*	Element
lowerUncertainty	*int/float*	0..1	*xs:integer/xs:double*	Element
upperUncertainty	*int/float*	0..1	*xs:integer/xs:double*	Element
confidenceLevel	*float*	0..1	*xs:double*	Element

Description of Attributes

value Value of the quantity. The unit is implicitly defined and depends on the context.

uncertainty Uncertainty as the absolute value of symmetric deviation from the main value.

lowerUncertainty Uncertainty as the absolute value of deviation from the main value towards smaller values.

upperUncertainty Uncertainty as the absolute value of deviation from the main value towards larger values.

confidenceLevel Confidence level of the uncertainty, given in percent.

Specification of a quantity (magnitude) with asymmetric errors: $M = 6.5^{+0.2}_{-0.1}$. Note that the minus sign of the lower uncertainty does not appear inside the XML element.

```
<mag>
    <value>6.5</value>
    <lowerUncertainty>0.1</lowerUncertainty>
    <upperUncertainty>0.2</upperUncertainty>
</mag>
```

Specification of a quantity (magnitude) with symmetric error and 1σ confidence interval: $M = 6.5 \pm 0.2$.

```
<mag>
    <value>6.5</value>
    <uncertainty>0.2</uncertainty>
    <confidenceLevel>68.3</confidenceLevel>
</mag>
```

3.3.3. TimeQuantity

This type describes a point in time, given in ISO 8601 format, with optional symmetric or asymmetric uncertainties given in seconds. The time has to be specified in UTC.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
value	*datetime*	1	*xs:dateTime*	Element
uncertainty	*float*	0..1	*xs:double*	Element
lowerUncertainty	*float*	0..1	*xs:double*	Element
upperUncertainty	*float*	0..1	*xs:double*	Element
confidenceLevel	*float*	0..1	*xs:double*	Element

value Point in time (UTC), given in ISO 8601 format (see Sect. 3.2.2).

uncertainty Symmetric uncertainty of point in time.
  Unit: s

lowerUncertainty Lower uncertainty of point in time.
  Unit: s

upperUncertainty Upper uncertainty of point in time.
  Unit: s

confidenceLevel Confidence level of the uncertainty, given in percent.

3.3.4. TimeWindow

Describes a time window for amplitude measurements, given by a central point in time, and points in time before and after this central point. Both points before and after may coincide with the central point.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
begin	*float*	1	*xs:double*	Element
end	*float*	1	*xs:double*	Element
reference	*datetime*	1	*xs:dateTime*	Element

Description of Attributes

begin Absolute value of duration of time interval before **reference** point in time window. The value may be zero, but not negative.
Unit: s

end Absolute value of duration of time interval after **reference** point in time window. The value may be zero, but not negative.
Unit: s

reference Reference point in time ("central" point), in ISO 8601 format. It has to be given in UTC (see Sect. 3.2.2).

3.3.5. WaveformStreamID

Reference to a stream description in an inventory. This is mostly equivalent to the combination of **networkCode**, **stationCode**, **locationCode**, and **channelCode**. However, additional information, e. g., sampling rate, can be referenced by the **resourceURI**. It is recommended to use **resourceURI** as a flexible, abstract, and unique stream ID that allows to describe different processing levels, or resampled/filtered products of the same initial stream, without violating the intrinsic meaning of the legacy identifiers (network, station, channel, and location codes). However, for operation in the context of legacy systems, the classical identifier components are supported.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
networkCode	*string*	1	*xs:string*	Attribute
stationCode	*string*	1	*xs:string*	Attribute
channelCode	*string*	0..1	*xs:string*	Attribute
locationCode	*string*	0..1	*xs:string*	Attribute
resourceURI	*ResourceReference*	0..1	*RI*	CDATA

Description of Attributes

networkCode Network code. String with a maximum length of 8 characters.

stationCode Station code. String with a maximum length of 8 characters.

channelCode Channel code. String with a maximum length of 8 characters.

locationCode Location code. String with a maximum length of 8 characters.

resourceURI Resource identifier for the waveform stream. QuakeML adopts in many places resource descriptors with a well-defined syntax for unambiguous resource identification. A brief introduction to the concept of resource identifiers can be found in Sect. 3.1. Resource identifiers are designed to be backward compatible with existing descriptors.

3.3.6. Phase

Generic and extensible phase description that currently contains the phase code only.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
code	*string*	1	*xs:string*	CDATA

Description of Attributes

code Phase code as given in the IASPEI Standard Seismic Phase List (Storchak et al. 2003). String with a maximum length of 32 characters.

3.3.7. CompositeTime

Focal times differ significantly in their precision. While focal times of instrumentally located earthquakes are estimated precisely down to seconds, historic events have only incomplete time descriptions. Sometimes, even contradictory information about the rupture time exist. The *CompositeTime* type allows for such complex descriptions. If the specification is given with no greater accuracy than days (i.e., no time components are given), the date refers to local time. However, if time components are given, they have to refer to UTC.

As an example, consider a historic earthquake in California, e.g., on 28 February 1730, with no time information given. Expressed in UTC, this day extends from 1730-02-28T08:00:00Z until 1730-03-01T08:00:00Z. Such a specification would be against intuition. Therefore, for date-time specifications without time components, local time is used. In the example, the *CompositeTime* attributes are simply **year** 1730, **month** 2, and **day** 28. In the corresponding **time** attribute of the origin, however, UTC has to be used. If the unknown time components are assumed to be zero, the value is 1730-02-28T08:00:00Z.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
year	*IntegerQuantity*	0..1	–	–
month	*IntegerQuantity*	0..1	–	–
day	*IntegerQuantity*	0..1	–	–
hour	*IntegerQuantity*	0..1	–	–
minute	*IntegerQuantity*	0..1	–	–
second	*RealQuantity*	0..1	–	–

Description of Attributes

year Year or range of years of the event's focal time.

month Month or range of months of the event's focal time.

day Day or range of days of the event's focal time.

hour Hour or range of hours of the event's focal time.

minute Minute or range of minutes of the event's focal time.

second Second and fraction of seconds or range of seconds with fraction of the event's focal time.

3.3.8. OriginQuality

This type contains various attributes commonly used to describe the quality of an origin, e. g., errors, azimuthal coverage, etc. *Origin* objects have an optional attribute of the type *OriginQuality*.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
associatedPhaseCount	*int*	0..1	*xs:integer*	Element
usedPhaseCount	*int*	0..1	*xs:integer*	Element
associatedStationCount	*int*	0..1	*xs:integer*	Element
usedStationCount	*int*	0..1	*xs:integer*	Element
depthPhaseCount	*int*	0..1	*xs:integer*	Element
standardError	*float*	0..1	*xs:double*	Element
azimuthalGap	*float*	0..1	*xs:double*	Element
secondaryAzimuthalGap	*float*	0..1	*xs:double*	Element
groundTruthLevel	*string*	0..1	*xs:string*	Element
minimumDistance	*float*	0..1	*xs:double*	Element
maximumDistance	*float*	0..1	*xs:double*	Element
medianDistance	*float*	0..1	*xs:double*	Element

Description of Attributes

associatedPhaseCount Number of associated phases, regardless of their use for origin computation.

usedPhaseCount Number of defining phases, i. e., phase observations that were actually used for computing the origin. Note that there may be more than one defining phase per station.

associatedStationCount Number of stations at which the event was observed.

usedStationCount Number of stations from which data was used for origin computation.

depthPhaseCount Number of depth phases (typically pP, sometimes sP) used in depth computation.

standardError RMS of the travel time residuals of the arrivals used for the origin computation.
  Unit: s

azimuthalGap Largest azimuthal gap in station distribution as seen from epicenter. For an illustration of azimuthal gap and secondary azimuthal gap (see below), see Fig. 5 of Bondár et al. (2004).
  Unit: deg

secondaryAzimuthalGap Secondary azimuthal gap in station distribution, i. e., the largest azimuthal gap a station closes.
  Unit: deg

groundTruthLevel String describing ground-truth level, e. g. GT0, GT5, etc. It has a maximum length of 32 characters.

minimumDistance Epicentral distance of station closest to the epicenter.
  Unit: deg

maximumDistance Epicentral distance of station farthest from the epicenter.
  Unit: deg

medianDistance Median epicentral distance of used stations.
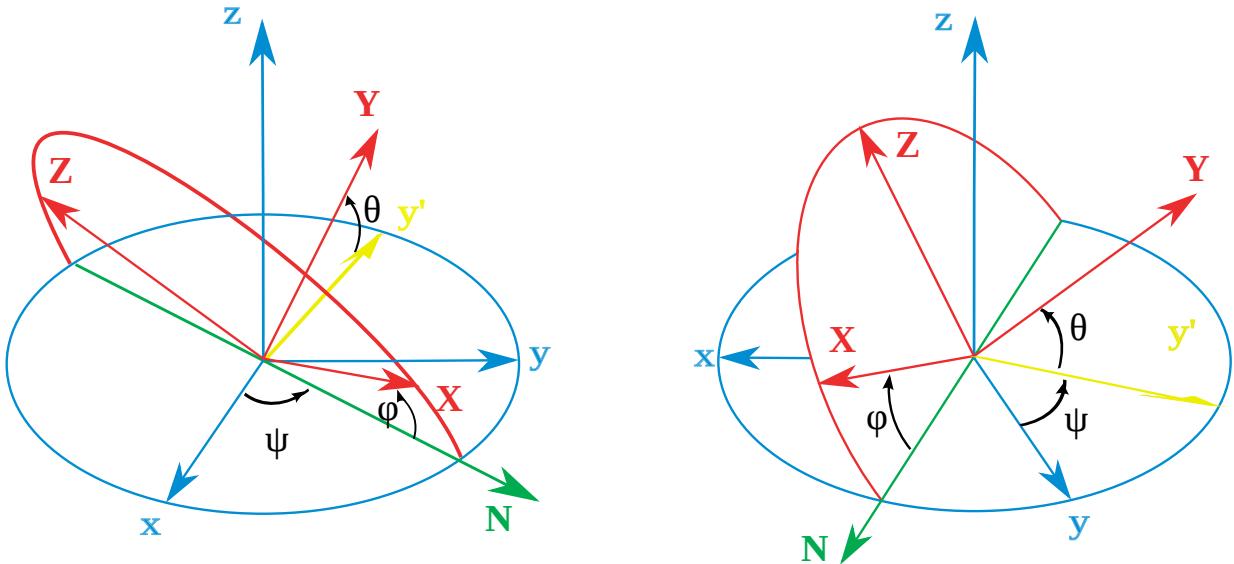 *Unit:* deg

Figure 4: Definition of Tait-Bryan angles. Figure copyright by Juansempere, published under the Creative Commons Attribution 3.0 Unported license. Source: Wikipedia, http://en.wikipedia.org/wiki/Euler_angles

3.3.9. ConfidenceEllipsoid

This class represents a description of the location uncertainty as a confidence ellipsoid with arbitrary orientation in space. The orientation of a rigid body in three-dimensional Euclidean space can be described by three parameters. We use the convention of Euler angles, which can be interpreted as a composition of three elemental rotations (i.e., rotations around a single axis). In the special case of Euler angles we use here, the angles are referred to as Tait-Bryan (or Cardan) angles. These angles may be familiar to the reader from their application in flight dynamics, and are referred to as heading (yaw, ψ), elevation (attitude, pitch, φ), and bank (roll, θ). For a definition of the angles, see Figure 4. Through the three elemental rotations, a Cartesian system (x, y, z) centered at the epicenter, with the South-North direction x, the West-East direction y, and the downward vertical direction z, is transferred into a different Cartesian system (X, Y, Z) centered on the confidence ellipsoid. Here, X denotes the direction of the major axis, and Y denotes the direction of the minor axis of the ellipsoid. Note that Figure 4 can be interpreted as a hypothetical view from the *interior* of the Earth to the inner face of a shell representing Earth's surface.

The three Tait-Bryan rotations are performed as follows: (i) a rotation about the Z axis with angle ψ (heading, or azimuth); (ii) a rotation about the Y axis with angle φ (elevation, or plunge); and (iii) a rotation about the X axis with angle θ (bank). Note that in the case of Tait-Bryan angles, the rotations are performed about the ellipsoid's axes, not about the axes of the fixed (x, y, z) Cartesian system.

In the following table the correspondence of the attributes of class *ConfidenceEllipsoid* to the respective Tait-Bryan angles is listed.

Attribute	Tait-Bryan angle	Symbol (Fig. 4)
majorAxisPlunge	elevation (pitch)	φ
majorAxisAzimuth	heading (yaw)	ψ
majorAxisRotation	bank (roll)	θ

Attribute	UML Type	Multiplicity	XML Type	XML Representation
semiMajorAxisLength	*float*	1	*xs:double*	Element
semiMinorAxisLength	*float*	1	*xs:double*	Element
semiIntermediateAxisLength	*float*	1	*xs:double*	Element
majorAxisPlunge	*float*	1	*xs:double*	Element
majorAxisAzimuth	*float*	1	*xs:double*	Element
majorAxisRotation	*float*	1	*xs:double*	Element

Description of Attributes

semiMajorAxisLength Largest uncertainty, corresponding to the semi-major axis of the confidence ellipsoid.
Unit: m

semiMinorAxisLength Smallest uncertainty, corresponding to the semi-minor axis of the confidence ellipsoid.
Unit: m

semiIntermediateAxisLength Uncertainty in direction orthogonal to major and minor axes of the confidence ellipsoid.
Unit: m

majorAxisPlunge Plunge angle of major axis of confidence ellipsoid. Corresponds to Tait-Bryan angle φ.
Unit: deg

majorAxisAzimuth Azimuth angle of major axis of confidence ellipsoid. Corresponds to Tait-Bryan angle ψ.
Unit: deg

majorAxisRotation This angle describes a rotation about the confidence ellipsoid's major axis which is required to define the direction of the ellipsoid's minor axis. Corresponds to Tait-Bryan angle θ.
Unit: deg

3.3.10. NodalPlanes

This class describes the nodal planes of a double-couple moment-tensor solution. The attribute **preferredPlane** can be used to define which plane is the preferred one.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
nodalPlane1	*NodalPlane*	0..1	–	–
nodalPlane2	*NodalPlane*	0..1	–	–
preferredPlane	*int*	0..1	*xs:integer*	Attribute

Description of Attributes

nodalPlane1 First nodal plane of double-couple moment tensor solution.

nodalPlane2 Second nodal plane of double-couple moment tensor solution.

preferredPlane Indicator for preferred nodal plane of moment tensor solution. It can take integer values 1 or 2.

XML example

See Sect. 3.5.6.

3.3.11. PrincipalAxes

This class describes the principal axes of a double-couple moment tensor solution. **tAxis** and **pAxis** are required, while **nAxis** is optional.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
tAxis	*Axis*	1	–	–
pAxis	*Axis*	1	–	–
nAxis	*Axis*	0..1	–	–

Description of Attributes

tAxis T (tension) axis of a double-couple moment tensor solution.

pAxis P (pressure) axis of a double-couple moment tensor solution.

nAxis N (neutral) axis of a double-couple moment tensor solution.

XML example

See Sect. 3.5.6.

3.3.12. NodalPlane

This class describes a nodal plane using the attributes **strike**, **dip**, and **rake**. For a definition of the angles see Aki and Richards (1980).

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
strike	*RealQuantity*	1	–	–
dip	*RealQuantity*	1	–	–
rake	*RealQuantity*	1	–	–

Description of Attributes

strike Strike angle of nodal plane.
    Unit: deg

dip Dip angle of nodal plane.
    Unit: deg

rake Rake angle of nodal plane.
    Unit: deg

XML example

See Sect. 3.5.6.

3.3.13. Axis

This class describes an eigenvector of a moment tensor expressed in its principal-axes system. It uses the angles **azimuth**, **plunge**, and the eigenvalue **length**.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
azimuth	*RealQuantity*	1	–	–
plunge	*RealQuantity*	1	–	–
length	*RealQuantity*	1	–	–

Description of Attributes

azimuth Azimuth of eigenvector of moment tensor expressed in principal-axes system. Measured clockwise from South-North direction at epicenter.
Unit: deg

plunge Plunge of eigenvector of moment tensor expressed in principal-axes system. Measured against downward vertical direction at epicenter.
Unit: deg

length Eigenvalue of moment tensor expressed in principal-axes system.
Unit: N m

XML example

See Sect. 3.5.6.

3.3.14. Tensor

The *Tensor* class represents the six moment-tensor elements M_{rr}, M_{tt}, M_{pp}, M_{rt}, M_{rp}, M_{tp} in the spherical coordinate system defined by local upward vertical (r), North-South (t), and West-East (p) directions. See Aki and Richards (1980) for conversions to other coordinate systems.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
Mrr	*RealQuantity*	1	–	–
Mtt	*RealQuantity*	1	–	–
Mpp	*RealQuantity*	1	–	–
Mrt	*RealQuantity*	1	–	–
Mrp	*RealQuantity*	1	–	–
Mtp	*RealQuantity*	1	–	–

Description of Attributes

Mrr Moment-tensor element M_{rr}.
Unit: N m

Mtt Moment-tensor element M_{tt}.
Unit: N m

Mpp Moment-tensor element M_{pp}.
Unit: N m

Mrt Moment-tensor element M_{rt}.
Unit: N m

Mrp Moment-tensor element M_{rp}.
Unit: N m

Mtp Moment-tensor element M_{tp}.
　　　Unit: N m

3.3.15. DataUsed

The *DataUsed* class describes the type of data that has been used for a moment-tensor inversion.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
waveType	*enum (DataUsedWaveType)*	1	–	Element
stationCount	*int*	0..1	*xs:integer*	Element
componentCount	*int*	0..1	*xs:integer*	Element
shortestPeriod	*float*	0..1	*xs:double*	Element
longestPeriod	*float*	0..1	*xs:double*	Element

Description of Attributes

waveType Type of waveform data. This can be one of the following values:

DataUsedWaveType (enum)

- `P waves`
- `body waves`
- `surface waves`
- `mantle waves`
- `combined`
- `unknown`

---

stationCount Number of stations that have contributed data of the type given in **waveType**.

componentCount Number of data components of the type given in **waveType**.

shortestPeriod Shortest period present in data.
　　　Unit: s

longestPeriod Longest period present in data.
　　　Unit: s

3.3.16. SourceTimeFunction

Source time function used in moment-tensor inversion.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
type	*enum (SourceTimeFunctionType)*	1	–	Element
duration	*float*	1	*xs:double*	Element
riseTime	*float*	0..1	*xs:double*	Element
decayTime	*float*	0..1	*xs:double*	Element

type Type of source time function. Values can be taken from the following:

> **SourceTimeFunction (enum)**
> - `box car`
> - `triangle`
> - `trapezoid`
> - `unknown`

duration Source time function duration.
>   *Unit:* s

riseTime Source time function rise time.
>   *Unit:* s

decayTime Source time function decay time.
>   *Unit:* s

3.3.17. EventDescription

Free-form string with additional event description. This can be a well-known name, like `1906 San Francisco Earthquake`. A number of categories can be given in **type**.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
text	*string*	1	*xs:string*	Element
type	*enum (EventDescriptionType)*	0..1	–	Element

text Free-form text with earthquake description.

type Category of earthquake description. Values can be taken from the following:

> **EventDescriptionType (enum)**
> - `felt report`
> - `Flinn-Engdahl region`
> - `local time`
> - `tectonic summary`
> - `nearest cities`
> - `earthquake name`
> - `region name`

3.3.18. CreationInfo

CreationInfo is used to describe creation metadata (author, version, and creation time) of a resource.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
agencyID	*string*	0..1	*xs:string*	Element
agencyURI	*ResourceReference*	0..1	*RI*	Element
author	*string*	0..1	*xs:string*	Element
authorURI	*ResourceReference*	0..1	*RI*	Element
creationTime	*datetime*	0..1	*xs:dateTime*	Element
version	*string*	0..1	*xs:string*	Element

Description of Attributes

agencyID Designation of agency that published a resource. The string has a maximum length of 64 characters.

agencyURI RI of the agency that published a resource.

author Name describing the author of a resource. The string has a maximum length of 128 characters.

authorURI RI of the author of a resource.

creationTime Time of creation of a resource, in ISO 8601 format. It has to be given in UTC (see Sect. 3.2.2).

version Version string of a resource.

3.3.19. Comment

Comment holds information on comments to a resource as well as author and creation time information.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
text	*string*	1	*xs:string*	Element
id	*ResourceReference*	0..1	*RI*	Attribute
creationInfo	*CreationInfo*	0..1	–	–

Description of Attributes

text Text of comment.

id Identifier of comment, in QuakeML RI format.

creationInfo *CreationInfo* for the *Comment* object.

3.4. Common Enumerations

In this section enumerations that are used in more than one class are listed. Enumerations which are specific to only one class are presented within the context of the class.

3.4.1. EvaluationMode

Mode of an evaluation (used in *Pick*, *Amplitude*, *Magnitude*, *Origin*, *FocalMechanism*). Allowed values are

- `manual`
- `automatic`.

3.4.2. EvaluationStatus

Status of of an evaluation (used in *Pick*, *Amplitude*, *Magnitude*, *Origin*, *FocalMechanism*). Allowed values are

- `preliminary`
- `confirmed`
- `reviewed`
- `final`
- `rejected`.

3.5. Elements

3.5.1. EventParameters

In the bulletin-type (non real-time) model, this class serves as a container for *Event* objects. In the real-time version, it can hold objects of type *Event*, *Origin*, *Magnitude*, *StationMagnitude*, *FocalMechanism*, *Reading*, *Amplitude*, and *Pick*.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
description	*string*	0..1	*xs:string*	Element
comment	*Comment*	0..∗	–	–
creationInfo	*CreationInfo*	0..1	–	–

List of child elements

Attribute	UML Type	Multiplicity
event	*Event*	0..∗
only in real-time variant:		
origin	*Origin*	0..∗
magnitude	*Magnitude*	0..∗
stationMagnitude	*StationMagnitude*	0..∗
focalMechanism	*FocalMechanism*	0..∗
reading	*Reading*	0..∗
pick	*Pick*	0..∗
amplitude	*Amplitude*	0..∗

Description of Attributes

publicID Resource identifier of *EventParameters*.

description Description string that can be assigned to the earthquake catalog, or collection of events.

comment Additional comments.

creationInfo *CreationInfo* for the earthquake catalog.

XML example

```
<eventParameters publicID="smi:ch.ethz.sed/catalog/switzerland/1">
    <event>...</event>
    <event>...</event>
</eventParameters>
```

3.5.2. Event

The class *Event* describes a seismic event which does not necessarily need to be a tectonic earthquake. An event is usually associated with one or more origins, which contain information about focal time and geographical location of the event. Multiple origins can cover automatic and manual locations, a set of location from different agencies, locations generated with different location programs and earth models, etc. Furthermore, an event is usually associated with one or more magnitudes, and with one or more focal mechanism determinations. In

standard QuakeML-BED, *Origin*, *Magnitude*, *StationMagnitude*, and *FocalMechanism* are child elements of *Event*. In BED-RT all these elements are on the same hierarchy level as child elements of *EventParameters*. The association of origins, magnitudes, and focal mechanisms to a particular event is expressed using references inside *Event*.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
preferredOriginID	*ResourceReference*	0..1	*RI*	Element
preferredMagnitudeID	*ResourceReference*	0..1	*RI*	Element
preferredFocalMechanismID	*ResourceReference*	0..1	*RI*	Element
type	*enum (EventType)*	0..1	–	Element
typeCertainty	*enum (EventTypeCertainty)*	0..1	–	Element
description	*EventDescription*	0..*	–	–
comment	*Comment*	0..*	–	–
creationInfo	*CreationInfo*	0..1	–	–
only in real-time variant:				
originReference	*ResourceReference*	0..*	*RI*	Element
magnitudeReference	*ResourceReference*	0..*	*RI*	Element
focalMechanismReference	*ResourceReference*	0..*	*RI*	Element

List of child elements

Attribute	UML Type	Multiplicity
only in bulletin (non-RT) variant:		
origin	*Origin*	0..*
magnitude	*Magnitude*	0..*
stationMagnitude	*StationMagnitude*	0..*
focalMechanism	*FocalMechanism*	0..*
pick	*Pick*	0..*
amplitude	*Amplitude*	0..*

Description of Attributes

publicID Resource identifier of *Event*.

preferredOriginID Refers to the **publicID** of the preferred *Origin* object.

preferredMagnitudeID Refers to the **publicID** of the preferred *Magnitude* object.

preferredFocalMechanismID Refers to the **publicID** of the preferred *FocalMechanism* object.

type Describes the type of an event (Storchak et al. 2012). Allowed values are the following:

EventType (enum)

- not existing
- not reported
- earthquake
- anthropogenic event
- collapse
- cavity collapse
- mine collapse
- building collapse
- explosion
- accidental explosion
- chemical explosion
- controlled explosion
- experimental explosion
- industrial explosion
- mining explosion
- quarry blast
- road cut
- blasting levee
- nuclear explosion
- induced or triggered event
- rock burst
- reservoir loading
- fluid injection
- fluid extraction
- crash
- plane crash
- train crash
- boat crash
- other event
- atmospheric event
- sonic boom
- sonic blast
- acoustic noise
- thunder
- avalanche
- snow avalanche
- debris avalanche
- hydroacoustic event
- ice quake

```
EventType (enum), continued
    • slide
    • landslide
    • rockslide
    • meteorite
    • volcanic eruption
```

typeCertainty Denotes how certain the information on event type is (Storchak et al. 2012). Allowed values are the following:

```
EventTypeCertainty (enum)
    • known
    • suspected
```

description Additional event description, like earthquake name, Flinn-Engdahl region, etc.

comment Comments.

creationInfo *CreationInfo* for the *Event* object.

originReference Reference to an associated *Origin*. If a **preferredOriginID** is given, it has to be repeated as an **originReference**, so that all **originReference** elements form a complete list of associated origins. This attribute is only applicable for the real-time variant (BED-RT).

magnitudeReference Reference to an associated *Magnitude*. If a **preferredMagnitudeID** is given, it has to be repeated as an **magnitudeReference**, so that all **magnitudeReference** elements form a complete list of associated magnitudes. This attribute is only applicable for the real-time variant (BED-RT).

focalMechanismReference Reference to an associated *FocalMechanism*. If a **preferredFocalMechanismID** is given, it has to be repeated as an **focalMechanismReference**, so that all **focalMechanismReference** elements form a complete list of associated focal mechanisms. This attribute is only applicable for the real-time variant (BED-RT).

XML example

```
<event publicID="smi:ch.ethz.sed/event/historical/1165">
    <preferredOriginID>smi:ch.ethz.sed/origin/2054</preferredOriginID>
    <preferredMagnitudeID>smi:ch.ethz.sed/magnitude/1015</preferredMagnitudeID>
    <preferredFocalMechanismID>smi:ch.ethz.sed/fm/23151</preferredFocalMechanismID>
  <type>earthquake</type>
  <description>
      <text>1356 Basel Earthquake</text>
      <type>earthquake name</type>
  </description>
  <comment>
      <text>Relocated after re-evaluation of historical intensity reports</text>
  </comment>
</event>
```

3.5.3. Origin

This class represents the focal time and geographical location of an earthquake hypocenter, as well as additional meta-information. *Origin* can have objects of type *OriginUncertainty* and *Arrival* as child elements.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
time	*TimeQuantity*	1	–	–
longitude	*RealQuantity*	1	–	–
latitude	*RealQuantity*	1	–	–
depth	*RealQuantity*	0..1	–	–
depthType	*enum (OriginDepthType)*	0..1	–	Element
timeFixed	*boolean*	0..1	*xs:boolean*	Element
epicenterFixed	*boolean*	0..1	*xs:boolean*	Element
referenceSystemID	*ResourceReference*	0..1	*RI*	Element
methodID	*ResourceReference*	0..1	*RI*	Element
earthModelID	*ResourceReference*	0..1	*RI*	Element
compositeTime	*CompositeTime*	0..*	–	–
quality	*OriginQuality*	0..1	–	–
type	*enum (OriginType)*	0..1	–	Element
region	*string*	0..1	*xs:string*	Element
evaluationMode	*enum (EvaluationMode)*	0..1	–	Element
evaluationStatus	*enum (EvaluationStatus)*	0..1	–	Element
comment	*Comment*	0..*	–	–
creationInfo	*CreationInfo*	0..1	–	–

List of child elements

Attribute	UML Type	Multiplicity
arrival	*Arrival*	0..*
originUncertainty	*OriginUncertainty*	0..1

Description of Attributes

publicID Resource identifier of *Origin*.

time Focal time.

longitude Hypocenter longitude, with respect to the World Geodetic System 1984 (WGS84) reference system (National Imagery and Mapping Agency 2000).
Unit: deg

latitude Hypocenter latitude, with respect to the WGS84 reference system.
Unit: deg

depth Depth of hypocenter with respect to the nominal sea level given by the WGS84 geoid (Earth Gravitational Model, EGM96, Lemoine et al. 1998). Positive values indicate hypocenters below sea level. For shallow hypocenters, the **depth** value can be negative. Note: Other standards use different conventions for depth measurement. As an example, GSE 2.0, defines depth with respect to the local surface. If event data is converted from other formats to QuakeML, depth values may have to be modified accordingly.
Unit: m

depthType Type of depth determination. Allowed values are the following:

> **OriginDepthType (enum)**
> - `from location`
> - `from moment tensor inversion`
> - `from from modeling of broad-band P waveforms`
> - `constrained by depth phases`
> - `constrained by direct phases`
> - `constrained by depth and direct phases`
> - `operator assigned`
> - `other.`

timeFixed Boolean flag. True if focal time was kept fixed for computation of the *Origin*.

epicenterFixed Boolean flag. True if epicenter was kept fixed for computation of *Origin*.

referenceSystemID Identifies the reference system used for hypocenter determination. This is only necessary if a modified version of the standard (with local extensions) is used that provides a non-standard coordinate system.

methodID Identifies the method used for locating the event.

earthModelID Identifies the earth model used in **methodID**.

compositeTime Supplementary information on time of rupture start. Complex descriptions of focal times of historic events are possible, see description of the *CompositeTime* type. Note that even if **compositeTime** is used, the mandatory **time** attribute has to be set, too. It has to be set to the single point in time (with uncertainties allowed) that is most characteristic for the event.

quality Additional parameters describing the quality of an *Origin* determination.

type Describes the *Origin* type. Allowed values are the following:

> **OriginType (enum)**
> - `hypocenter`
> - `centroid`
> - `amplitude`
> - `macroseismic`
> - `rupture start`
> - `rupture end`

region Can be used to decribe the geographical region of the epicenter location. Useful if an event has multiple origins from different agencies, and these have different region designations. Note that an event-wide region can be defined in the **description** attribute of an *Event* object. The user has to take care that this information corresponds to the region attribute of the preferred *Origin*. String with maximum length of 255 chars.

evaluationMode Evaluation mode of *Origin* (see Sect. 3.4.1).

evaluationStatus Evaluation status of *Origin* (see Sect. 3.4.2).

comment Additional comments.

creationInfo *CreationInfo* for the *Origin* object.

XML example

```
<origin publicID="smi:org.globalcmt/origin/C200501010120A">
    <time>
        <value>2005-01-01T01:20:05.1Z</value>
        <uncertainty>0.9</uncertainty>
    </time>
    <latitude>
        <value>13.76</value>
        <uncertainty>0.06</uncertainty>
    </latitude>
    <longitude>
        <value>-89.08</value>
        <uncertainty>0.09</uncertainty>
    </longitude>
    <depth>
        <value>162800</value>
        <uncertainty>12500</uncertainty>
    </depth>
    <depthType>from moment tensor inversion</depthType>
</origin>
```

3.5.4. OriginUncertainty

This class describes the location uncertainties of an origin. The uncertainty can be described either as a simple circular horizontal uncertainty, an uncertainty ellipse according to IMS1.0, or a confidence ellipsoid. If multiple uncertainty models are given, the preferred variant can be specified in the attribute **preferredDescription**.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
horizontalUncertainty	*float*	0..1	*xs:double*	Element
minHorizontalUncertainty	*float*	0..1	*xs:double*	Element
maxHorizontalUncertainty	*float*	0..1	*xs:double*	Element
azimuthMaxHorizontalUncertainty	*float*	0..1	*xs:double*	Element
confidenceEllipsoid	*ConfidenceEllipsoid*	0..1	–	–
preferredDescription	*enum (OriginUncertaintyDescription)*	0..1	–	Element
confidenceLevel	*float*	0..1	*xs:double*	Element

Description of Attributes

horizontalUncertainty Circular confidence region, given by single value of horizontal uncertainty.
   Unit: m

minHorizontalUncertainty compositeTime Semi-minor axis of confidence ellipse.
   Unit: m

maxHorizontalUncertainty Semi-major axis of confidence ellipse.
   Unit: m

azimuthMaxHorizontalUncertainty Azimuth of major axis of confidence ellipse. Measured clockwise from South-North direction at epicenter.
   Unit: deg

confidenceEllipsoid Confidence ellipsoid (see Sect. 3.3.9).

preferredDescription Preferred uncertainty description. Allowed values are the following:

> **OriginUncertaintyDescription (enum)**
> - `horizontal uncertainty`
> - `uncertainty ellipse`
> - `confidence ellipsoid`

confidenceLevel Confidence level of the uncertainty, given in percent.

XML example

```
<originUncertainty>
    <preferredDescription>uncertainty ellipse</preferredDescription>
    <horizontalUncertainty>9000</horizontalUncertainty>
    <minHorizontalUncertainty>6000</minHorizontalUncertainty>
    <maxHorizontalUncertainty>10000</maxHorizontalUncertainty>
    <azimuthMaxHorizontalUncertainty>80.0</azimuthMaxHorizontalUncertainty>
</originUncertainty>
```

3.5.5. Magnitude

Describes a magnitude which can, but does not need to be associated with an origin. Association with an origin is expressed with the optional attribute **originID**. It is either a combination of different magnitude estimations, or it represents the reported magnitude for the given event.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute

List of child elements

Attribute	UML Type	Multiplicity
stationMagnitudeContribution	*StationMagnitudeContribution*	0..∗

Description of Attributes

publicID Resource identifier of *Magnitude*.

mag Resulting magnitude value from combining values of type *StationMagnitude*. If no estimations are available, this value can represent the reported magnitude.

type Describes the type of magnitude. This is a free-text field because it is impossible to cover all existing magnitude type designations with an enumeration. Possible values are unspecified magitude (`M`), local magnitude (`ML`), body wave magnitude (`Mb`), surface wave magnitude (`MS`), moment magnitude (`Mw`), duration magnitude (`Md`), coda magnitude (`Mc`), `MH`, `Mwp`, `M50`, `M100`, etc.

originID Reference to an origin's **publicID** if the magnitude has an associated *Origin*.

methodID Identifies the method of magnitude estimation. Users should avoid to give contradictory information in **methodID** and **type**.

stationCount Number of used stations for this magnitude computation.

azimuthalGap Azimuthal gap for this magnitude computation.
Unit: deg

evaluationMode Evaluation mode of *Magnitude* (see Sect. 3.4.1).

evaluationStatus Evaluation status of *Magnitude* (see Sect. 3.4.2).

comment Additional comments.

creationInfo *CreationInfo* for the *Magnitude* object.

XML example

```
<magnitude publicID="smi:ch.ethz.sed/magnitude/37465">
    <mag>
        <value>5.5</value>
        <uncertainty>0.1</uncertainty>
    </mag>
    <type>MS</type>
    <methodID>smi:ch.ethz.sed/magnitude/generic/surface_wave_magnitude</methodID>
    <stationCount>8</stationCount>
</magnitude>
```

3.5.6. FocalMechanism

This class describes the focal mechanism of an event. It includes different descriptions like nodal planes, principal axes, and a moment tensor. The moment tensor description is provided by objects of the class *MomentTensor* which can be specified as child elements of *FocalMechanism*.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
triggeringOriginID	*ResourceReference*	0..1	*RI*	Element
nodalPlanes	*NodalPlanes*	0..1	–	–
principalAxes	*PrincipalAxes*	0..1	–	–
azimuthalGap	*float*	0..1	*xs:double*	Element
stationPolarityCount	*int*	0..1	*xs:integer*	Element
misfit	*float*	0..1	*xs:double*	Element
stationDistributionRatio	*float*	0..1	*xs:double*	Element
methodID	*ResourceReference*	0..1	*RI*	Element
waveformID	*WaveformStreamID*	0..*	–	–
evaluationMode	*enum (EvaluationMode)*	0..1	–	Element
evaluationStatus	*enum (EvaluationMode)*	0..1	–	Element
comment	*Comment*	0..*	–	–
creationInfo	*CreationInfo*	0..1	–	–

List of child elements

Attribute	UML Type	Multiplicity
momentTensor	*MomentTensor*	0..1

Description of Attributes

publicID Resource identifier of *FocalMechanism*.

triggeringOriginID Refers to the **publicID** of the triggering origin.

nodalPlanes Nodal planes of the focal mechanism.

principalAxes Principal axes of the focal mechanism.

azimuthalGap Largest azimuthal gap in distribution of stations used for determination of focal mechanism.
Unit: deg

stationPolarityCount Number of station polarities used for determination of focal mechanism.

misfit Fraction of misfit polarities in a first-motion focal mechanism determination. Decimal fraction between 0 and 1.

stationDistributionRatio Station distribution ratio (STDR) parameter. Indicates how the stations are distributed about the focal sphere (Reasenberg and Oppenheimer 1985). Decimal fraction between 0 and 1.

methodID Resource identifier of the method used for determination of the focal mechanism.

waveformID Refers to a set of waveform streams from which the focal mechanism was derived.

evaluationMode Evaluation mode of *FocalMechanism* (see Sect. 3.4.1).

evaluationStatus Evaluation status of *FocalMechanism* (see Sect. 3.4.2).

comment Additional comments.

creationInfo *CreationInfo* for the *FocalMechanism* object.

XML example

```
<focalMechanism publicID="smi:org.globalcmt/fm/C200501010120A">
    <nodalPlanes>
        <nodalPlane1>
            <strike>
                <value>9.0</value>
            </strike>
            <dip>
                <value>29.0</value>
            </dip>
            <rake>
                <value>142.0</value>
            </rake>
        </nodalPlane1>
        <nodalPlane2>
            <strike>
                <value>133.0</value>
            </strike>
            <dip>
                <value>72.0</value>
            </dip>
            <rake>
                <value>66.0</value>
            </rake>
        </nodalPlane2>
    </nodalPlanes>
    <evaluationMode>manual</evaluationMode>
    <evaluationStatus>confirmed</evaluationStatus>
</focalMechanism>
```

3.5.7. MomentTensor

This class represents a moment tensor solution for an event. It is an optional part of a *FocalMechanism* description.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
derivedOriginID	*ResourceReference*	1	*RI*	Element
momentMagnitudeID	*ResourceReference*	0..1	*RI*	Element
scalarMoment	*RealQuantity*	0..1	–	–
tensor	*Tensor*	0..1	–	–
variance	*float*	0..1	*xs:double*	Element
varianceReduction	*float*	0..1	*xs:double*	Element
doubleCouple	*float*	0..1	*xs:double*	Element
clvd	*float*	0..1	*xs:double*	Element
iso	*float*	0..1	*xs:double*	Element
greensFunctionID	*ResourceReference*	0..1	*RI*	Element
filterID	*ResourceReference*	0..1	*RI*	Element
sourceTimeFunction	*SourceTimeFunction*	0..1	–	–
dataUsed	*DataUsed*	0..1	–	–
methodID	*ResourceReference*	0..1	*RI*	Element
category	*enum (MomentTensorCategory)*	0..1	–	Element
inversionType	*enum (MTInversionType)*	0..1	–	Element
comment	*Comment*	0..*	–	–
creationInfo	*CreationInfo*	0..1	–	–

Description of Attributes

publicID Resource identifier of *MomentTensor*.

derivedOriginID Refers to the **publicID** of the *Origin* derived in the moment tensor inversion.

momentMagnitudeID Refers to the **publicID** of the *Magnitude* object which represents the derived moment magnitude.

scalarMoment Scalar moment as derived in moment tensor inversion.
Unit: N m

tensor *Tensor* object holding the moment tensor elements.

variance Variance of moment tensor inversion.

varianceReduction Variance reduction of moment tensor inversion, given in percent (Dreger 2003). This is a goodness-of-fit measure.

doubleCouple Double couple parameter obtained from moment tensor inversion (decimal fraction between 0 and 1).

clvd CLVD (compensated linear vector dipole) parameter obtained from moment tensor inversion (decimal fraction between 0 and 1).

iso Isotropic part obtained from moment tensor inversion (decimal fraction between 0 and 1).

greensFunctionID Resource identifier of the Green's function used in moment tensor inversion.

filterID Resource identifier of the filter setup used in moment tensor inversion.

sourceTimeFunction Source time function used in moment-tensor inversion.

dataUsed Describes waveform data used for moment-tensor inversion.

methodID Resource identifier of the method used for moment-tensor inversion.

category Category of moment tensor inversion. Valid entries are given in the following list:

MomentTensorCategory (enum)
- teleseismic
- regional

---

inversionType Type of moment tensor inversion. Users should avoid to give contradictory information in **inversionType** and **methodID**. Valid entries are given in the following list:

MTInversionType (enum)
- general
- zero trace
- double couple

---

comment Additional comments.

creationInfo *CreationInfo* for the *MomentTensor* object.

```
<momentTensor>
     <derivedOriginID>smi:org.globalcmt/origin/C200501010120A</derivedOriginID>
    <scalarMoment>
        <value>1.312e15</value>
    </scalarMoment>
    <tensor>
        <Mrr>
            <value>0.838e15</value>
            <uncertainty>0.201e15</uncertainty>
        </Mrr>
        <Mtt>
            <value>-0.005e15</value>
            <uncertainty>0.231e15</uncertainty>
        </Mtt>
        <Mpp>
            <value>-0.833e15</value>
            <uncertainty>0.270e15</uncertainty>
        </Mpp>
        <Mrt>
            <value>1.050e15</value>
            <uncertainty>0.121e15</uncertainty>
        </Mrt>
        <Mrp>
            <value>-0.369e15</value>
            <uncertainty>0.161e15</uncertainty>
        </Mrp>
        <Mtp>
            <value>0.044e15</value>
            <uncertainty>0.240e15</uncertainty>
        </Mtp>
    </tensor>
    <dataUsed>
        <waveType>long-period body waves</waveType>
        <stationCount>4</stationCount>
        <componentCount>4</componentCount>
        <shortestPeriod>40.0</shortestPeriod>
    </dataUsed>
    <sourceTimeFunction>
        <type>triangle</type>
        <duration>0.6</duration>
    </sourceTimeFunction>
    <category>teleseismic</category>
    <inversionType>zero trace</inversionType>
    <creationInfo>
        <creationTime>2005-03-22T12:52:01Z</creationTime>
    </creationInfo>
</momentTensor>
```

3.5.8. StationMagnitude

This class describes the magnitude derived from a single waveform stream.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
originID	*ResourceReference*	1	*RI*	Element
mag	*RealQuantity*	1	–	–
type	*string*	0..1	*xs:string*	Element
amplitudeID	*ResourceReference*	0..1	*RI*	Element
methodID	*ResourceReference*	0..1	*RI*	Element
waveformID	*WaveformStreamID*	0..1	–	–
comment	*Comment*	0..*	–	–
creationInfo	*CreationInfo*	0..1	–	–

Description of Attributes

publicID Resource identifier of *StationMagnitude*.

originID Reference to an origin's **publicID** if the *StationMagnitude* has an associated *Origin*.

mag Estimated magnitude.

type See class *Magnitude* (Sect. 3.5.5).

amplitudeID Identifies the data source of the *StationMagnitude*. For magnitudes derived from amplitudes in waveforms (e. g., local magnitude M_L), **amplitudeID** points to **publicID** in class *Amplitude*.

methodID See class *Magnitude* (Sect. 3.5.5).

waveformID Identifies the waveform stream. This element can be helpful if no amplitude is referenced, or the amplitude is not available in the context. Otherwise, it would duplicate the **waveformID** provided there and can be omitted.

comment Additional comments.

creationInfo *CreationInfo* for the *StationMagnitude* object.

XML example

```
<stationMagnitude publicID="smi:ch.ethz.sed/magnitude/station/881342">
    <mag>
        <value>4.5</value>
        <uncertainty>0.2</uncertainty>
    </mag>
    <methodID>smi:ch.ethz.sed/magnitude/generic/surface_wave_magnitude</methodID>
    <stationAmplitudeID>smi:ch.ethz.sed/amplitude/824315</stationAmplitudeID>
    <type>MS</type>
    <waveformID networkCode="CH" stationCode="DAVOX">
        smi:ch.ethz.sed/waveform/201754</waveformID>
</stationMagnitude>
```

3.5.9. StationMagnitudeContribution

This class describes the weighting of magnitude values from several *StationMagnitude* objects for computing a network magnitude estimation.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
stationMagnitudeID	*ResourceReference*	1	*RI*	Element
residual	*float*	0..1	*xs:double*	Element
weight	*float*	0..1	*xs:double*	Element

Description of Attributes

stationMagnitudeID Refers to the **publicID** of a *StationMagnitude* object.

residual Residual of magnitude computation.

weight Weight of the magnitude value from class *StationMagnitude* for computing the magnitude value in class *Magnitude*. Note that there is no rule for the sum of the weights of all station magnitude contributions to a specific network magnitude. In particular, the weights are not required to sum up to unity.

XML example

```
<stationMagnitudeContribution>
    <stationMagnitudeID>smi:ch.ethz.sed/magnitude/station/55897</stationMagnitudeID>
    <weight>0.15</weight>
</stationMagnitudeContribution>
```

3.5.10. Arrival

Successful association of a pick with an origin qualifies this pick as an arrival. An arrival thus connects a pick with an origin and provides additional attributes that describe this relationship. Usually qualification of a pick as an arrival for a given origin is a hypothesis, which is based on assumptions about the type of arrival (phase) as well as observed and (on the basis of an earth model) computed arrival times, or the residual, respectively. Additional pick attributes like the horizontal slowness and backazimuth of the observed wave—especially if derived from array data—may further constrain the nature of the arrival.

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
pickID	*ResourceReference*	1	*RI*	Element
phase	*Phase*	1	–	–
timeCorrection	*float*	0..1	*xs:double*	Element
azimuth	*float*	0..1	*xs:double*	Element
distance	*float*	0..1	*xs:double*	Element
takeoffAngle	*RealQuantity*	0..1	–	–
timeResidual	*float*	0..1	*xs:double*	Element
horizontalSlownessResidual	*float*	0..1	*xs:double*	Element
backazimuthResidual	*float*	0..1	*xs:double*	Element
timeWeight	*float*	0..1	*xs:double*	Element
horizontalSlownessWeight	*float*	0..1	*xs:double*	Element
backazimuthWeight	*float*	0..1	*xs:double*	Element
earthModelID	*ResourceReference*	0..1	*RI*	Element
comment	*Comment*	0..*	–	–
creationInfo	*CreationInfo*	0..1	–	–

Description of Attributes

publicID Resource identifier of *Arrival*.

pickID Refers to a **publicID** of a *Pick*.

phase Phase identification. For possible values, please refer to the description of the *Phase* type (Sect. 3.3.6).

timeCorrection Time correction value. Usually, a value characteristic for the station at which the pick was detected, sometimes also characteristic for the phase type or the slowness.
   Unit: s

azimuth Azimuth of station as seen from the epicenter.
   Unit: deg

distance Epicentral distance.
   Unit: deg

takeoffAngle Angle of emerging ray at the source, measured against the downward normal direction.
   Unit: deg

timeResidual Residual between observed and expected arrival time assuming proper phase identification and given the **earthModelID** of the *Origin*, taking into account the **timeCorrection**.
   Unit: s

horizontalSlownessResidual Residual of horizontal slowness and the expected slowness given the current origin (refers to attribute **horizontalSlowness** of class *Pick*).
   Unit: $\mathrm{s \cdot deg^{-1}}$

backazimuthResidual Residual of backazimuth and the backazimuth computed for the current origin (refers to attribute **backazimuth** of class *Pick*).
   Unit: deg

timeWeight Weight of the arrival time for computation of the associated *Origin*. Note that the sum of all weights is not required to be unity.

horizontalSlownessWeight Weight of the horizontal slowness for computation of the associated *Origin*. Note that the sum of all weights is not required to be unity.

backazimuthWeight Weight of the backazimuth for computation of the associated *Origin*. Note that the sum of all weights is not required to be unity.

earthModelID Earth model which is used for the association of *Arrival* to *Pick* and computation of the residuals.

comment Additional comments.

creationInfo *CreationInfo* for the *Arrival* object.

XML example

```
<arrival>
    <pickID>smi:ch.ethz.sed/pick/117634</pickID>
    <phase>Pn</phase>
    <azimuth>12.0</azimuth>
    <distance>0.5</distance>
    <earthModelID>smi:ch.ethz.sed/earthmodel/U21</earthModelID>
</arrival>
```

3.5.11. Pick

A pick is the observation of an amplitude anomaly in a seismogram at a specific point in time. It is not necessarily related to a seismic event.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
time	*TimeQuantity*	1	–	–
waveformID	*WaveformStreamID*	1	–	–
filterID	*ResourceReference*	0..1	*RI*	Element
methodID	*ResourceReference*	0..1	*RI*	Element
horizontalSlowness	*RealQuantity*	0..1	–	–
backazimuth	*RealQuantity*	0..1	–	–
slownessMethodID	*ResourceReference*	0..1	*RI*	Element
onset	*enum (PickOnset)*	0..1	–	Element
phaseHint	*Phase*	0..1	–	–
polarity	*enum (PickPolarity)*	0..1	–	Element
evaluationMode	*enum (EvaluationMode)*	0..1	–	Element
evaluationStatus	*enum (EvaluationStatus)*	0..1	–	Element
comment	*Comment*	0..∗	–	–
creationInfo	*CreationInfo*	0..1	–	–

Description of Attributes

publicID Resource identifier of *Pick*.

time Observed onset time of signal ("pick time").

waveformID Identifes the waveform stream.

filterID Identifies the filter or filter setup used for filtering the waveform stream referenced by **waveformID**.

methodID Identifies the picker that produced the pick. This can be either a detection software program or a person.

horizontalSlowness Observed horizontal slowness of the signal. Most relevant in array measurements. *Unit:* $s \cdot deg^{-1}$

backazimuth Observed backazimuth of the signal. Most relevant in array measurements. *Unit:* deg

slownessMethodID Identifies the method that was used to determine the slowness.

onset Flag that roughly categorizes the sharpness of the onset. Allowed values are:

PickOnset (enum)
- `impulsive`
- `emergent`
- `questionable`.
---

phaseHint Tentative phase identification as specified by the picker.

polarity Indicates the polarity of first motion, usually from impulsive onsets. Allowed values are:

PickPolarity (enum)
- `positive`
- `negative`
- `undecidable`
---

evaluationMode Evaluation mode of *Pick* (see Sect. 3.4.1).

evaluationStatus Evaluation status of *Pick* (see Sect. 3.4.2).

comment Additional comments.

creationInfo *CreationInfo* for the *Pick* object.

XML example

```
<pick publicID="smi:ch.ethz.sed/pick/117634">
    <time>
        <value>2005-09-18T22:04:35Z</value>
        <uncertainty>0.012</uncertainty>
    </time>
    <waveformID networkCode="CH" stationCode="DAVOX">
        smi:ch.ethz.sed/waveform/201754</waveformID>
    <filterID>smi:ch.ethz.sed/filter/lowpass/standard</filterID>
    <methodID>smi:ch.ethz.sed/picker/autopicker/6.0.2</methodID>
    <backazimuth>
        <value>44.0</value>
    </backazimuth>
    <onset>impulsive</onset>
    <phaseHint>Pn</phaseHint>
    <polarity>positive</polarity>
    <evaluationMode>manual</evaluationMode>
    <evaluationStatus>confirmed</evaluationStatus>
</pick>
```

3.5.12. Amplitude

This class represents a quantification of the waveform anomaly, usually a single amplitude measurement or a measurement of the visible signal duration for duration magnitudes.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
genericAmplitude	*RealQuantity*	1	–	–
type	*string*	0..1	*xs:string*	Element
category	*enum (AmplitudeCategory)*	0..1	–	Element
unit	*enum (AmplitudeUnit)*	0..1	–	Element
methodID	*ResourceReference*	0..1	*RI*	Element
period	*RealQuantity*	0..1	–	–
snr	*float*	0..1	*xs:double*	Element
timeWindow	*TimeWindow*	0..1	–	–
pickID	*ResourceReference*	0..1	*RI*	Element
waveformID	*WaveformStreamID*	0..1	–	–
filterID	*ResourceReference*	0..1	*RI*	Element
scalingTime	*TimeQuantity*	0..1	–	–
magnitudeHint	*string*	0..1	*xs:string*	Element
evaluationMode	*enum (EvaluationMode)*	0..1	–	Element
evaluationStatus	*enum (EvaluationStatus)*	0..1	–	Element
comment	*Comment*	0..∗	–	–
creationInfo	*CreationInfo*	0..1	–	–

Description of Attributes

publicID Resource identifier of *Amplitude*.

genericAmplitude Measured amplitude value for the given **waveformID**. Note that this attribute can describe different physical quantities, depending on the **type** and **category** of the amplitude. These can be, e.g., displacement, velocity, or a period. If the only amplitude information is a period, it has to specified here, not in the **period** attribute. The latter can be used if the amplitude measurement contains information on, e.g., displacement and an additional period. Since the physical quantity described by this attribute is not fixed, the unit of measurement cannot be defined in advance. However, the quantity has to be specified in SI base units. The enumeration given in attribute **unit** provides the most likely units that could be needed here. For clarity, using the optional **unit** attribute is highly encouraged.

type String that describes the type of amplitude using the nomenclature from Storchak et al. (2003). Possible values include unspecified amplitude reading (A), amplitude reading for local magnitude (AML), amplitude reading for body wave magnitude (AMB), amplitude reading for surface wave magnitude (AMS), and time of visible end of record for duration magnitude (END). It has a maximum length of 32 characters.

category This attribute describes the way the waveform trace is evaluated to derive an amplitude value. This can be just reading a single value for a given point in time (point), taking a mean value over a time interval (mean), integrating the trace over a time interval (integral), specifying just a time interval (duration), or evaluating a period (period).

AmplitudeCategory (enum)

- point
- mean
- duration
- period
- integral
- other

---

unit This attribute provides the most likely measurement units for the physical quantity described in the **genericAmplitude** attribute. Possible values are specified as combinations of SI base units.

AmplitudeUnit (enum)

- m
- s
- m/s
- m/(s*s)
- m*s
- dimensionless
- other

---

methodID Describes the method of amplitude determination.

period Dominant period in the **timeWindow** in case of amplitude measurements. Not used for duration magnitude.
Unit: s

snr Signal-to-noise ratio of the spectrogram at the location the amplitude was measured.

timeWindow Description of the time window used for amplitude measurement. Recommended for duration magnitudes.

pickID Refers to the **publicID** of an associated *Pick* object.

waveformID Identifies the waveform stream on which the amplitude was measured.

filterID Identifies the filter or filter setup used for filtering the waveform stream referenced by **waveformID**.

scalingTime Scaling time for amplitude measurement.

magnitudeHint Type of magnitude the amplitude measurement is used for. For valid values see class *Magnitude* (Sect. 3.5.5). String value with a maximum length of 32 characters.

evaluationMode Evaluation mode of *Amplitude* (see Sect. 3.4.1).

evaluationStatus Evaluation status of *Amplitude* (see Sect. 3.4.2).

comment Additional comments.

creationInfo *CreationInfo* for the *Amplitude* object.

```
<amplitude publicID="smi:ch.ethz.sed/amplitude/962435">
    <displacement>
        <value>1.5e-6</value>
        <uncertainty>0.2e-6</uncertainty>
    </displacement>
    <type>AL</type>
    <pickID>smi:ch.ethz.sed/pick/20238</pickID>
    <waveformID networkCode="CH" stationCode="DAVOX">
        smi:ch.ethz.sed/waveform/33826</waveformID>
    <filterID>smi:ch.ethz.sed/filter/wood_anderson/1.2</filterID>
    <methodID>smi:ch.ethz.sed/amplitude/generic/AL</methodID>
</amplitude>
```

3.5.13. Reading

Used only in BED-RT as child element of *EventParameters*. This class groups *Pick* and *Amplitude* elements which are thought to belong to the same event, but for which the event identification is not known.

List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
publicID	*ResourceReference*	1	*RI*	Attribute
pickReference	*ResourceReference*	0..∗	*RI*	Element
amplitudeReference	*ResourceReference*	0..∗	*RI*	Element

Description of Attributes

publicID Resource identifier of *Reading*.

pickReference Reference to the **publicID** of a *Pick* object.

amplitudeReference Reference to the **publicID** of an *Amplitude* object.

XML example

```
<reading publicID="smi:ch.ethz.sed/reading/962435">
    <pickReference>smi:ch.ethz.sed/pick/924235</pickReference>
    <amplitudeReference>smi:ch.ethz.sed/amlitude/367523</amplitudeReference>
</reading>
```

4. References

Aki, K. and P. G. Richards (1980). Quantitative Seismology. W.H. Freeman, San Francisco. 19, 20

Berners-Lee, T., R. Fielding, and L. Masinter (1998). Uniform Resource Identifier (URI): Generic Syntax (IETF RFC 2396). http://www.ietf.org/rfc/rfc2396.txt. 10

Bondár, I., S. C. Myers, E. R. Engdahl, and E. A. Bergman (2004). Epicentre accuracy based on seismic network criteria. Geophys. J. Int., 156, 483–496. doi:10.1111/j.1365-246X.2004.02070.x. 16

Bray, T., J. Paoli, C. M. Sperberg-McQueen, and E. Maler (2000). Extensible Markup Language (XML) 1.0, Second Edition, W3C Recommendation, 6 October 2000. http://www.w3.org/TR/2000/REC-xml-20001006. 5

Dreger, D. S. (2003). 85.11 TDMT_INV: Time domain seismic moment tensor INVersion. In W. H. K. Lee, H. Kanamori, P. C. Jennings, and C. Kisslinger, eds., International Handbook of Earthquake and Engineering Seismology, Academic Press, vol. 81, Part B of International Geophysics, 1627. doi:10.1016/S0074-6142(03) 80290-5. 37

Dublin Core Metadata Initiative (2003). Dublin Core Metadata Element Set, Version 1.1: Reference Description, 02 June 2003. http://dublincore.org/documents/2003/06/02/dces/. 11

Lemoine, F. G., S. C. Kenyon, J. K. Factor, R. G. Trimmer, N. K. Pavlis, D. S. Chinn, C. M. Cox, S. M. Klosko, S. B. Luthcke, M. H. Torrence, Y. M. Wang, R. G. Williamson, E. C. Pavlis, R. H. Rapp, and T. R. Olson (1998). The Development of the Joint NASA GSFC and the National Imagery and Mapping Agency (NIMA) Geopotential Model EGM96, NASA/TP-1998-206861. http://cddis.nasa.gov/926/egm96/nasatm.html. 30

National Imagery and Mapping Agency (2000). Department of Defense World Geodetic System 1984, NIMA TR8350.2. http://earth-info.nga.mil/GandG/publications/tr8350.2/wgs84fin.pdf. 30

Reasenberg, P. and D. Oppenheimer (1985). FPFIT, FPPLOT, and FPPAGE: Fortran computer programs for calculating and displaying earthquake fault-plane solutions. Open-File Report No. 85-739. U.S. Geological Survey, Menlo Park. http://pubs.usgs.gov/of/1985/0739/report.pdf. 35

Schorlemmer, D., A. Wyss, S. Maraini, S. Wiemer, and M. Baer (2004). QuakeML—An XML schema for seismology. ORFEUS Newsletter, 6(2), 9. http://www.orfeus-eu.org/Organization/Newsletter/vol6no2/quakeml.shtml. 5

Storchak, D., P. Earle, R. Bossu, B. Presgrave, J. Harris, and S. Godey (2012). Nomenclature of Event Types (unpublished draft). 27, 29

Storchak, D. A., J. Schweitzer, and P. Bormann (2003). The IASPEI Standard Seismic Phase List. Seismol. Res. Lett., 74(6), 761–772. ftp://ftp.isc.ac.uk/pub/docs/srl_sspl.pdf. 15, 45

A. QuakeML—XML Schema Description

In this Section the XML Schema descriptions for QuakeML BED and QuakeML BED-RT, version 1.2, are listed. The schemas can also be found online[11].

A.1. QuakeML BED, Version 1.2

A.1.1. Umbrella Schema (QuakeML-1.2.xsd)

```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
           targetNamespace="http://quakeml.org/xmlns/quakeml/1.2"
           xmlns="http://quakeml.org/xmlns/quakeml/1.2"
           xmlns:bed="http://quakeml.org/xmlns/bed/1.2"
           elementFormDefault="qualified"
           attributeFormDefault="unqualified">

  <xs:import namespace="http://quakeml.org/xmlns/bed/1.2" schemaLocation="QuakeML-BED-1.2.
        xsd"/>

  <xs:complexType name="Quakeml">
    <xs:all>
      <xs:element ref="bed:eventParameters" minOccurs="0" maxOccurs="1"/>
    </xs:all>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>

  <xs:element name="quakeml" type="Quakeml"/>

</xs:schema>
```

A.1.2. Basic Event Description Package (QuakeML-BED-1.2.xsd)

```
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:bed="http://quakeml.org/xmlns
       /bed/1.2" xmlns="http://quakeml.org/xmlns/bed/1.2" targetNamespace="http://quakeml.
       org/xmlns/bed/1.2" elementFormDefault="qualified" attributeFormDefault="unqualified
       ">
  <xs:simpleType name="ResourceIdentifier">
    <xs:restriction base="xs:anyURI">
      <xs:pattern value="(smi|quakeml):[\w\d][\w\d\-\.\*\(\)_~']{2,}/[\w\d\-\.\*\(\)_~'][\
            w\d\-\.\*\(\)\+\?_~'=,;#/&amp;]*"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="WhitespaceOrEmptyStringType">
    <xs:restriction base="xs:string">
      <xs:pattern value="\s*"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="ResourceReference_optional">
    <xs:union memberTypes="bed:ResourceReference bed:WhitespaceOrEmptyStringType"/>
  </xs:simpleType>
  <xs:simpleType name="OriginUncertaintyDescription">
    <xs:restriction base="xs:string">
      <xs:enumeration value="horizontal uncertainty"/>
      <xs:enumeration value="uncertainty ellipse"/>
      <xs:enumeration value="confidence ellipsoid"/>
    </xs:restriction>
```

---

[11]BED: http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-1.2.xsd, http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-BED-1.2.xsd, BED-RT: http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-BED-1.2.xsd, http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-RT-BED-1.2.xsd.

```
    </xs:simpleType>
    <xs:simpleType name="AmplitudeCategory">
      <xs:restriction base="xs:string">
        <xs:enumeration value="point"/>
        <xs:enumeration value="mean"/>
        <xs:enumeration value="duration"/>
        <xs:enumeration value="period"/>
        <xs:enumeration value="integral"/>
        <xs:enumeration value="other"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="OriginDepthType">
      <xs:restriction base="xs:string">
        <xs:enumeration value="from location"/>
        <xs:enumeration value="from moment tensor inversion"/>
        <xs:enumeration value="from modeling of broad-band P waveforms"/>
        <xs:enumeration value="constrained by depth phases"/>
        <xs:enumeration value="constrained by direct phases"/>
        <xs:enumeration value="constrained by depth and direct phases"/>
        <xs:enumeration value="operator assigned"/>
        <xs:enumeration value="other"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="OriginType">
      <xs:restriction base="xs:string">
        <xs:enumeration value="hypocenter"/>
        <xs:enumeration value="centroid"/>
        <xs:enumeration value="amplitude"/>
        <xs:enumeration value="macroseismic"/>
        <xs:enumeration value="rupture start"/>
        <xs:enumeration value="rupture end"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="MTInversionType">
      <xs:restriction base="xs:string">
        <xs:enumeration value="general"/>
        <xs:enumeration value="zero trace"/>
        <xs:enumeration value="double couple"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="EvaluationMode">
      <xs:restriction base="xs:string">
        <xs:enumeration value="manual"/>
        <xs:enumeration value="automatic"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="EvaluationStatus">
      <xs:restriction base="xs:string">
        <xs:enumeration value="preliminary"/>
        <xs:enumeration value="confirmed"/>
        <xs:enumeration value="reviewed"/>
        <xs:enumeration value="final"/>
        <xs:enumeration value="rejected"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="PickOnset">
      <xs:restriction base="xs:string">
        <xs:enumeration value="emergent"/>
        <xs:enumeration value="impulsive"/>
        <xs:enumeration value="questionable"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:simpleType name="EventType">
      <xs:restriction base="xs:string">
        <xs:enumeration value="not existing"/>
        <xs:enumeration value="not reported"/>
        <xs:enumeration value="earthquake"/>
        <xs:enumeration value="anthropogenic event"/>
```

```
        <xs:enumeration value="collapse"/>
        <xs:enumeration value="cavity collapse"/>
        <xs:enumeration value="mine collapse"/>
        <xs:enumeration value="building collapse"/>
        <xs:enumeration value="explosion"/>
        <xs:enumeration value="accidental explosion"/>
        <xs:enumeration value="chemical explosion"/>
        <xs:enumeration value="controlled explosion"/>
        <xs:enumeration value="experimental explosion"/>
        <xs:enumeration value="industrial explosion"/>
        <xs:enumeration value="mining explosion"/>
        <xs:enumeration value="quarry blast"/>
        <xs:enumeration value="road cut"/>
        <xs:enumeration value="blasting levee"/>
        <xs:enumeration value="nuclear explosion"/>
        <xs:enumeration value="induced or triggered event"/>
        <xs:enumeration value="rock burst"/>
        <xs:enumeration value="reservoir loading"/>
        <xs:enumeration value="fluid injection"/>
        <xs:enumeration value="fluid extraction"/>
        <xs:enumeration value="crash"/>
        <xs:enumeration value="plane crash"/>
        <xs:enumeration value="train crash"/>
        <xs:enumeration value="boat crash"/>
        <xs:enumeration value="other event"/>
        <xs:enumeration value="atmospheric event"/>
        <xs:enumeration value="sonic boom"/>
        <xs:enumeration value="sonic blast"/>
        <xs:enumeration value="acoustic noise"/>
        <xs:enumeration value="thunder"/>
        <xs:enumeration value="avalanche"/>
        <xs:enumeration value="snow avalanche"/>
        <xs:enumeration value="debris avalanche"/>
        <xs:enumeration value="hydroacoustic event"/>
        <xs:enumeration value="ice quake"/>
        <xs:enumeration value="slide"/>
        <xs:enumeration value="landslide"/>
        <xs:enumeration value="rockslide"/>
        <xs:enumeration value="meteorite"/>
        <xs:enumeration value="volcanic eruption"/>
    </xs:restriction>
</xs:simpleType>
<xs:simpleType name="DataUsedWaveType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="P waves"/>
        <xs:enumeration value="body waves"/>
        <xs:enumeration value="surface waves"/>
        <xs:enumeration value="mantle waves"/>
        <xs:enumeration value="combined"/>
        <xs:enumeration value="unknown"/>
    </xs:restriction>
</xs:simpleType>
<xs:simpleType name="AmplitudeUnit">
    <xs:restriction base="xs:string">
        <xs:enumeration value="m"/>
        <xs:enumeration value="s"/>
        <xs:enumeration value="m/s"/>
        <xs:enumeration value="m/(s*s)"/>
        <xs:enumeration value="m*s"/>
        <xs:enumeration value="dimensionless"/>
        <xs:enumeration value="other"/>
    </xs:restriction>
</xs:simpleType>
<xs:simpleType name="EventDescriptionType">
    <xs:restriction base="xs:string">
        <xs:enumeration value="felt report"/>
        <xs:enumeration value="Flinn-Engdahl region"/>
        <xs:enumeration value="local time"/>
```

```xml
        <xs:enumeration value="tectonic summary"/>
        <xs:enumeration value="nearest cities"/>
        <xs:enumeration value="earthquake name"/>
        <xs:enumeration value="region name"/>
      </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="MomentTensorCategory">
    <xs:restriction base="xs:string">
      <xs:enumeration value="teleseismic"/>
      <xs:enumeration value="regional"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="EventTypeCertainty">
    <xs:restriction base="xs:string">
      <xs:enumeration value="known"/>
      <xs:enumeration value="suspected"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="SourceTimeFunctionType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="box car"/>
      <xs:enumeration value="triangle"/>
      <xs:enumeration value="trapezoid"/>
      <xs:enumeration value="unknown"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="PickPolarity">
    <xs:restriction base="xs:string">
      <xs:enumeration value="positive"/>
      <xs:enumeration value="negative"/>
      <xs:enumeration value="undecidable"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="TimeQuantity">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="value" minOccurs="1" maxOccurs="1" type="xs:dateTime"/>
        <xs:element name="uncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="lowerUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="upperUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="confidenceLevel" minOccurs="0" maxOccurs="1" type="xs:double"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:simpleType name="ResourceReference">
    <xs:restriction base="bed:ResourceIdentifier"/>
  </xs:simpleType>
  <xs:complexType name="CreationInfo">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="agencyID" minOccurs="0" maxOccurs="1">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="64"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
        <xs:element name="agencyURI" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="author" minOccurs="0" maxOccurs="1">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="128"/>
            </xs:restriction>
          </xs:simpleType>
```

```
      </xs:element>
      <xs:element name="authorURI" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="creationTime" minOccurs="0" maxOccurs="1" type="xs:dateTime"/>
      <xs:element name="version" minOccurs="0" maxOccurs="1">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:maxLength value="64"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:element>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="EventDescription">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="text" minOccurs="1" maxOccurs="1" type="xs:string"/>
      <xs:element name="type" minOccurs="0" maxOccurs="1" type="bed:EventDescriptionType
            "/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Phase">
  <xs:simpleContent>
    <xs:extension base="xs:string">
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="Comment">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="text" minOccurs="1" maxOccurs="1" type="xs:string"/>
      <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
            "/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:attribute name="id" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Axis">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="azimuth" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="plunge" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="length" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="PrincipalAxes">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="tAxis" minOccurs="1" maxOccurs="1" type="bed:Axis"/>
      <xs:element name="pAxis" minOccurs="1" maxOccurs="1" type="bed:Axis"/>
      <xs:element name="nAxis" minOccurs="0" maxOccurs="1" type="bed:Axis"/>
    </xs:choice>
```

```
            <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
                "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="DataUsed">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="waveType" minOccurs="1" maxOccurs="1" type="bed:DataUsedWaveType
            "/>
        <xs:element name="stationCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
        <xs:element name="componentCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
        <xs:element name="shortestPeriod" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="longestPeriod" minOccurs="0" maxOccurs="1" type="xs:double"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="CompositeTime">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="year" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
        <xs:element name="month" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
        <xs:element name="day" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
        <xs:element name="hour" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
        <xs:element name="minute" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
        <xs:element name="second" minOccurs="0" maxOccurs="1" type="bed:RealQuantity"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="Tensor">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="Mrr" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="Mtt" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="Mpp" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="Mrt" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="Mrp" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="Mtp" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="OriginQuality">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="associatedPhaseCount" minOccurs="0" maxOccurs="1" type="
            xs:integer"/>
        <xs:element name="usedPhaseCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
        <xs:element name="associatedStationCount" minOccurs="0" maxOccurs="1" type="
            xs:integer"/>
        <xs:element name="usedStationCount" minOccurs="0" maxOccurs="1" type="xs:integer"/
            >
        <xs:element name="depthPhaseCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
        <xs:element name="standardError" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="azimuthalGap" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="secondaryAzimuthalGap" minOccurs="0" maxOccurs="1" type="
            xs:double"/>
        <xs:element name="groundTruthLevel" minOccurs="0" maxOccurs="1">
          <xs:simpleType>
            <xs:restriction base="xs:string">
```

```xml
              <xs:maxLength value="32"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
        <xs:element name="maximumDistance" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="minimumDistance" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="medianDistance" minOccurs="0" maxOccurs="1" type="xs:double"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="RealQuantity">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="value" minOccurs="1" maxOccurs="1" type="xs:double"/>
        <xs:element name="uncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="lowerUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="upperUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="confidenceLevel" minOccurs="0" maxOccurs="1" type="xs:double"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="NodalPlane">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="strike" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="dip" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        <xs:element name="rake" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      </xs:choice>
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          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
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  <xs:complexType name="TimeWindow">
    <xs:sequence>
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        <xs:element name="end" minOccurs="1" maxOccurs="1" type="xs:double"/>
        <xs:element name="reference" minOccurs="1" maxOccurs="1" type="xs:dateTime"/>
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      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
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  </xs:complexType>
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    <xs:simpleContent>
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        <xs:attribute name="networkCode" use="required">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="8"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="stationCode" use="required">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="8"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:attribute>
```

```xml
      <xs:attribute name="channelCode">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:maxLength value="8"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:attribute>
      <xs:attribute name="locationCode">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:maxLength value="8"/>
          </xs:restriction>
        </xs:simpleType>
      </xs:attribute>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
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      <xs:element name="lowerUncertainty" minOccurs="0" maxOccurs="1" type="xs:integer"/
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            >
      <xs:element name="confidenceLevel" minOccurs="0" maxOccurs="1" type="xs:double"/>
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  <xs:anyAttribute namespace="##other" processContents="lax"/>
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    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="type" minOccurs="1" maxOccurs="1" type="
            bed:SourceTimeFunctionType"/>
      <xs:element name="duration" minOccurs="1" maxOccurs="1" type="xs:double"/>
      <xs:element name="riseTime" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="decayTime" minOccurs="0" maxOccurs="1" type="xs:double"/>
    </xs:choice>
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  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
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      <xs:element name="nodalPlane2" minOccurs="0" maxOccurs="1" type="bed:NodalPlane"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
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  </xs:sequence>
  <xs:attribute name="preferredPlane" type="xs:integer"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
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  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
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            "/>
      <xs:element name="semiMinorAxisLength" minOccurs="1" maxOccurs="1" type="xs:double
            "/>
```

```xml
        <xs:element name="semiIntermediateAxisLength" minOccurs="1" maxOccurs="1" type="
            xs:double"/>
        <xs:element name="majorAxisPlunge" minOccurs="1" maxOccurs="1" type="xs:double"/>
        <xs:element name="majorAxisAzimuth" minOccurs="1" maxOccurs="1" type="xs:double"/>
        <xs:element name="majorAxisRotation" minOccurs="1" maxOccurs="1" type="xs:double"/
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            "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="MomentTensor">
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      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="dataUsed" type="bed:DataUsed"/>
        <xs:element name="comment" type="bed:Comment"/>
        <xs:element name="derivedOriginID" minOccurs="1" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="momentMagnitudeID" minOccurs="0" maxOccurs="1" type="
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        <xs:element name="scalarMoment" minOccurs="0" maxOccurs="1" type="bed:RealQuantity
            "/>
        <xs:element name="tensor" minOccurs="0" maxOccurs="1" type="bed:Tensor"/>
        <xs:element name="variance" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="varianceReduction" minOccurs="0" maxOccurs="1" type="xs:double"/
            >
        <xs:element name="doubleCouple" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="clvd" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="iso" minOccurs="0" maxOccurs="1" type="xs:double"/>
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        <xs:element name="filterID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="sourceTimeFunction" minOccurs="0" maxOccurs="1" type="
            bed:SourceTimeFunction"/>
        <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="category" minOccurs="0" maxOccurs="1" type="
            bed:MomentTensorCategory"/>
        <xs:element name="inversionType" minOccurs="0" maxOccurs="1" type="
            bed:MTInversionType"/>
        <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
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      </xs:choice>
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    </xs:sequence>
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    <xs:anyAttribute namespace="##other" processContents="lax"/>
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  <xs:complexType name="FocalMechanism">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
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        <xs:element name="comment" type="bed:Comment"/>
        <xs:element name="momentTensor" type="bed:MomentTensor"/>
        <xs:element name="triggeringOriginID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="nodalPlanes" minOccurs="0" maxOccurs="1" type="bed:NodalPlanes"/
            >
        <xs:element name="principalAxes" minOccurs="0" maxOccurs="1" type="
            bed:PrincipalAxes"/>
        <xs:element name="azimuthalGap" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="stationPolarityCount" minOccurs="0" maxOccurs="1" type="xs:int"/
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        <xs:element name="misfit" minOccurs="0" maxOccurs="1" type="xs:double"/>
```

```
          <xs:element name="stationDistributionRatio" minOccurs="0" maxOccurs="1" type="
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          <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
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      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
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        <xs:element name="genericAmplitude" minOccurs="1" maxOccurs="1" type="
                bed:RealQuantity"/>
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              <xs:maxLength value="32"/>
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        </xs:element>
        <xs:element name="category" minOccurs="0" maxOccurs="1" type="
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        <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
                bed:ResourceReference"/>
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        <xs:element name="snr" minOccurs="0" maxOccurs="1" type="xs:double"/>
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        <xs:element name="pickID" minOccurs="0" maxOccurs="1" type="bed:ResourceReference"
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        <xs:element name="waveformID" minOccurs="0" maxOccurs="1" type="
                bed:WaveformStreamID"/>
        <xs:element name="filterID" minOccurs="0" maxOccurs="1" type="
                bed:ResourceReference"/>
        <xs:element name="scalingTime" minOccurs="0" maxOccurs="1" type="bed:TimeQuantity"
                />
        <xs:element name="magnitudeHint" minOccurs="0" maxOccurs="1">
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              <xs:maxLength value="32"/>
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          </xs:simpleType>
        </xs:element>
        <xs:element name="evaluationMode" minOccurs="0" maxOccurs="1" type="
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        <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
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      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
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    </xs:sequence>
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    <xs:anyAttribute namespace="##other" processContents="lax"/>
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```

```
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            <xs:maxLength value="32"/>
          </xs:restriction>
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      <xs:element name="evaluationStatus" minOccurs="0" maxOccurs="1" type="
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    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
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      <xs:element name="mag" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="type" minOccurs="0" maxOccurs="1">
        <xs:simpleType>
          <xs:restriction base="xs:string">
            <xs:maxLength value="32"/>
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        </xs:simpleType>
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      <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="waveformID" minOccurs="0" maxOccurs="1" type="
          bed:WaveformStreamID"/>
      <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
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  </xs:sequence>
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                    xs:double"/>
              <xs:element name="maxHorizontalUncertainty" minOccurs="0" maxOccurs="1" type="
                    xs:double"/>
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                    type="xs:double"/>
              <xs:element name="confidenceEllipsoid" minOccurs="0" maxOccurs="1" type="
                    bed:ConfidenceEllipsoid"/>
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                    bed:OriginUncertaintyDescription"/>
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          <xs:sequence>
            <xs:choice minOccurs="0" maxOccurs="unbounded">
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              <xs:element name="phase" minOccurs="1" maxOccurs="1" type="bed:Phase"/>
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              <xs:element name="timeResidual" minOccurs="0" maxOccurs="1" type="xs:double"/>
              <xs:element name="horizontalSlownessResidual" minOccurs="0" maxOccurs="1" type="
                    xs:double"/>
              <xs:element name="backazimuthResidual" minOccurs="0" maxOccurs="1" type="xs:double
                    "/>
              <xs:element name="timeWeight" minOccurs="0" maxOccurs="1" type="xs:double"/>
              <xs:element name="horizontalSlownessWeight" minOccurs="0" maxOccurs="1" type="
                    xs:double"/>
              <xs:element name="backazimuthWeight" minOccurs="0" maxOccurs="1" type="xs:double"/
                    >
              <xs:element name="earthModelID" minOccurs="0" maxOccurs="1" type="
                    bed:ResourceReference"/>
              <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
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            </xs:choice>
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          <xs:sequence>
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              <xs:element name="comment" type="bed:Comment"/>
              <xs:element name="originUncertainty" type="bed:OriginUncertainty"/>
              <xs:element name="arrival" type="bed:Arrival"/>
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              <xs:element name="longitude" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
              <xs:element name="latitude" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
              <xs:element name="depth" minOccurs="0" maxOccurs="1" type="bed:RealQuantity"/>
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        <xs:element name="timeFixed" minOccurs="0" maxOccurs="1" type="xs:boolean"/>
        <xs:element name="epicenterFixed" minOccurs="0" maxOccurs="1" type="xs:boolean"/>
        <xs:element name="referenceSystemID" minOccurs="0" maxOccurs="1" type="
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        <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
        <xs:element name="earthModelID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
        <xs:element name="quality" minOccurs="0" maxOccurs="1" type="bed:OriginQuality"/>
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        <xs:element name="evaluationMode" minOccurs="0" maxOccurs="1" type="
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        <xs:element name="evaluationStatus" minOccurs="0" maxOccurs="1" type="
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  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
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      <xs:element name="time" minOccurs="1" maxOccurs="1" type="bed:TimeQuantity"/>
      <xs:element name="waveformID" minOccurs="1" maxOccurs="1" type="
            bed:WaveformStreamID"/>
      <xs:element name="filterID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="horizontalSlowness" minOccurs="0" maxOccurs="1" type="
            bed:RealQuantity"/>
      <xs:element name="backazimuth" minOccurs="0" maxOccurs="1" type="bed:RealQuantity"
            />
      <xs:element name="slownessMethodID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="onset" minOccurs="0" maxOccurs="1" type="bed:PickOnset"/>
      <xs:element name="phaseHint" minOccurs="0" maxOccurs="1" type="bed:Phase"/>
      <xs:element name="polarity" minOccurs="0" maxOccurs="1" type="bed:PickPolarity"/>
      <xs:element name="evaluationMode" minOccurs="0" maxOccurs="1" type="
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      <xs:element name="evaluationStatus" minOccurs="0" maxOccurs="1" type="
            bed:EvaluationStatus"/>
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    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
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  <xs:sequence>
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      <xs:element name="comment" type="bed:Comment"/>
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```
          <xs:element name="focalMechanism" type="bed:FocalMechanism"/>
          <xs:element name="amplitude" type="bed:Amplitude"/>
          <xs:element name="magnitude" type="bed:Magnitude"/>
          <xs:element name="stationMagnitude" type="bed:StationMagnitude"/>
          <xs:element name="origin" type="bed:Origin"/>
          <xs:element name="pick" type="bed:Pick"/>
          <xs:element name="preferredOriginID" minOccurs="0" maxOccurs="1" type="
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          <xs:element name="preferredMagnitudeID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="preferredFocalMechanismID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="type" minOccurs="0" maxOccurs="1" type="bed:EventType"/>
          <xs:element name="typeCertainty" minOccurs="0" maxOccurs="1" type="
              bed:EventTypeCertainty"/>
          <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
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      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:complexType>
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          <xs:element name="description" minOccurs="0" maxOccurs="1" type="xs:string"/>
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        </xs:choice>
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            "/>
      </xs:sequence>
      <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:complexType>
    <xs:element name="eventParameters" type="bed:EventParameters"/>
</xs:schema>
```

A.2. QuakeML BED-RT, Version 1.2

A.2.1. Umbrella Schema (QuakeML-RT-1.2.xsd)

```
<?xml version ="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
           targetNamespace="http://quakeml.org/xmlns/quakeml-rt/1.2"
           xmlns="http://quakeml.org/xmlns/quakeml-rt/1.2"
           xmlns:bed="http://quakeml.org/xmlns/bed-rt/1.2"
           elementFormDefault="qualified"
           attributeFormDefault="unqualified">

  <xs:import namespace="http://quakeml.org/xmlns/bed-rt/1.2" schemaLocation="QuakeML-RT-
       BED-1.2.xsd"/>

  <xs:complexType name="Quakeml">
    <xs:all>
      <xs:element ref="bed:eventParameters" minOccurs="0" maxOccurs="1"/>
    </xs:all>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>

  <xs:element name="quakeml" type="Quakeml"/>

</xs:schema>
```

A.2.2. Basic Event Description Package (QuakeML-RT-BED-1.2.xsd)

```
<?xml version ="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:bed="http://quakeml.org/xmlns
     /bed-rt/1.2" xmlns="http://quakeml.org/xmlns/bed-rt/1.2" targetNamespace="http://
     quakeml.org/xmlns/bed-rt/1.2" elementFormDefault="qualified" attributeFormDefault="
     unqualified">
  <xs:simpleType name="ResourceIdentifier">
    <xs:restriction base="xs:anyURI">
      <xs:pattern value="(smi|quakeml):[\w\d][\w\d\-\.\*\(\)_~']{2,}/[\w\d\-\.\*\(\)_~'][\
           w\d\-\.\*\(\)\+\?_~'=,;#/&amp;]*"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="WhitespaceOrEmptyStringType">
    <xs:restriction base="xs:string">
      <xs:pattern value="\s*"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="ResourceReference_optional">
    <xs:union memberTypes="bed:ResourceReference bed:WhitespaceOrEmptyStringType"/>
  </xs:simpleType>
  <xs:simpleType name="OriginUncertaintyDescription">
    <xs:restriction base="xs:string">
      <xs:enumeration value="horizontal uncertainty"/>
      <xs:enumeration value="uncertainty ellipse"/>
      <xs:enumeration value="confidence ellipsoid"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="AmplitudeCategory">
    <xs:restriction base="xs:string">
      <xs:enumeration value="point"/>
      <xs:enumeration value="mean"/>
      <xs:enumeration value="duration"/>
      <xs:enumeration value="period"/>
      <xs:enumeration value="integral"/>
      <xs:enumeration value="other"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="OriginDepthType">
    <xs:restriction base="xs:string">
```

```
        <xs:enumeration value="from location"/>
        <xs:enumeration value="from moment tensor inversion"/>
        <xs:enumeration value="from modeling of broad-band P waveforms"/>
        <xs:enumeration value="constrained by depth phases"/>
        <xs:enumeration value="constrained by direct phases"/>
        <xs:enumeration value="constrained by depth and direct phases"/>
        <xs:enumeration value="operator assigned"/>
        <xs:enumeration value="other"/>
      </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="OriginType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="hypocenter"/>
      <xs:enumeration value="centroid"/>
      <xs:enumeration value="amplitude"/>
      <xs:enumeration value="macroseismic"/>
      <xs:enumeration value="rupture start"/>
      <xs:enumeration value="rupture end"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="MTInversionType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="general"/>
      <xs:enumeration value="zero trace"/>
      <xs:enumeration value="double couple"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="EvaluationMode">
    <xs:restriction base="xs:string">
      <xs:enumeration value="manual"/>
      <xs:enumeration value="automatic"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="EvaluationStatus">
    <xs:restriction base="xs:string">
      <xs:enumeration value="preliminary"/>
      <xs:enumeration value="confirmed"/>
      <xs:enumeration value="reviewed"/>
      <xs:enumeration value="final"/>
      <xs:enumeration value="rejected"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="PickOnset">
    <xs:restriction base="xs:string">
      <xs:enumeration value="emergent"/>
      <xs:enumeration value="impulsive"/>
      <xs:enumeration value="questionable"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="DataUsedWaveType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="P waves"/>
      <xs:enumeration value="body waves"/>
      <xs:enumeration value="surface waves"/>
      <xs:enumeration value="mantle waves"/>
      <xs:enumeration value="combined"/>
      <xs:enumeration value="unknown"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="AmplitudeUnit">
    <xs:restriction base="xs:string">
      <xs:enumeration value="m"/>
      <xs:enumeration value="s"/>
      <xs:enumeration value="m/s"/>
      <xs:enumeration value="m/(s*s)"/>
      <xs:enumeration value="m*s"/>
      <xs:enumeration value="dimensionless"/>
      <xs:enumeration value="other"/>
```

```
      </xs:restriction>
</xs:simpleType>
<xs:simpleType name="EventDescriptionType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="felt report"/>
    <xs:enumeration value="Flinn-Engdahl region"/>
    <xs:enumeration value="local time"/>
    <xs:enumeration value="tectonic summary"/>
    <xs:enumeration value="nearest cities"/>
    <xs:enumeration value="earthquake name"/>
    <xs:enumeration value="region name"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="MomentTensorCategory">
  <xs:restriction base="xs:string">
    <xs:enumeration value="teleseismic"/>
    <xs:enumeration value="regional"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="EventType">
  <xs:restriction base="xs:string">
    <xs:enumeration value="not existing"/>
    <xs:enumeration value="not reported"/>
    <xs:enumeration value="earthquake"/>
    <xs:enumeration value="anthropogenic event"/>
    <xs:enumeration value="collapse"/>
    <xs:enumeration value="cavity collapse"/>
    <xs:enumeration value="mine collapse"/>
    <xs:enumeration value="building collapse"/>
    <xs:enumeration value="explosion"/>
    <xs:enumeration value="accidental explosion"/>
    <xs:enumeration value="chemical explosion"/>
    <xs:enumeration value="controlled explosion"/>
    <xs:enumeration value="experimental explosion"/>
    <xs:enumeration value="industrial explosion"/>
    <xs:enumeration value="mining explosion"/>
    <xs:enumeration value="quarry blast"/>
    <xs:enumeration value="road cut"/>
    <xs:enumeration value="blasting levee"/>
    <xs:enumeration value="nuclear explosion"/>
    <xs:enumeration value="induced or triggered event"/>
    <xs:enumeration value="rock burst"/>
    <xs:enumeration value="reservoir loading"/>
    <xs:enumeration value="fluid injection"/>
    <xs:enumeration value="fluid extraction"/>
    <xs:enumeration value="crash"/>
    <xs:enumeration value="plane crash"/>
    <xs:enumeration value="train crash"/>
    <xs:enumeration value="boat crash"/>
    <xs:enumeration value="other event"/>
    <xs:enumeration value="atmospheric event"/>
    <xs:enumeration value="sonic boom"/>
    <xs:enumeration value="sonic blast"/>
    <xs:enumeration value="acoustic noise"/>
    <xs:enumeration value="thunder"/>
    <xs:enumeration value="avalanche"/>
    <xs:enumeration value="snow avalanche"/>
    <xs:enumeration value="debris avalanche"/>
    <xs:enumeration value="hydroacoustic event"/>
    <xs:enumeration value="ice quake"/>
    <xs:enumeration value="slide"/>
    <xs:enumeration value="landslide"/>
    <xs:enumeration value="rockslide"/>
    <xs:enumeration value="meteorite"/>
    <xs:enumeration value="volcanic eruption"/>
  </xs:restriction>
</xs:simpleType>
<xs:simpleType name="EventTypeCertainty">
```

```
    <xs:restriction base="xs:string">
      <xs:enumeration value="known"/>
      <xs:enumeration value="suspected"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="SourceTimeFunctionType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="box car"/>
      <xs:enumeration value="triangle"/>
      <xs:enumeration value="trapezoid"/>
      <xs:enumeration value="unknown"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="PickPolarity">
    <xs:restriction base="xs:string">
      <xs:enumeration value="positive"/>
      <xs:enumeration value="negative"/>
      <xs:enumeration value="undecidable"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="TimeQuantity">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="value" minOccurs="1" maxOccurs="1" type="xs:dateTime"/>
        <xs:element name="uncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="lowerUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="upperUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
        <xs:element name="confidenceLevel" minOccurs="0" maxOccurs="1" type="xs:double"/>
      </xs:choice>
      <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:simpleType name="ResourceReference">
    <xs:restriction base="bed:ResourceIdentifier"/>
  </xs:simpleType>
  <xs:complexType name="CreationInfo">
    <xs:sequence>
      <xs:choice minOccurs="0" maxOccurs="unbounded">
        <xs:element name="agencyID" minOccurs="0" maxOccurs="1">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="64"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
        <xs:element name="agencyURI" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="author" minOccurs="0" maxOccurs="1">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="128"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
        <xs:element name="authorURI" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
        <xs:element name="creationTime" minOccurs="0" maxOccurs="1" type="xs:dateTime"/>
        <xs:element name="version" minOccurs="0" maxOccurs="1">
          <xs:simpleType>
            <xs:restriction base="xs:string">
              <xs:maxLength value="64"/>
            </xs:restriction>
          </xs:simpleType>
        </xs:element>
      </xs:choice>
```

```
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="EventDescription">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="text" minOccurs="1" maxOccurs="1" type="xs:string"/>
      <xs:element name="type" minOccurs="0" maxOccurs="1" type="bed:EventDescriptionType
          "/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
        "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Phase">
  <xs:simpleContent>
    <xs:extension base="xs:string">
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="Comment">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="text" minOccurs="1" maxOccurs="1" type="xs:string"/>
      <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
          "/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
        "/>
  </xs:sequence>
  <xs:attribute name="id" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Axis">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="azimuth" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="plunge" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="length" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
        "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="PrincipalAxes">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="tAxis" minOccurs="1" maxOccurs="1" type="bed:Axis"/>
      <xs:element name="pAxis" minOccurs="1" maxOccurs="1" type="bed:Axis"/>
      <xs:element name="nAxis" minOccurs="0" maxOccurs="1" type="bed:Axis"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
        "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="DataUsed">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="waveType" minOccurs="1" maxOccurs="1" type="bed:DataUsedWaveType
          "/>
      <xs:element name="stationCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
      <xs:element name="componentCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
```

```
            <xs:element name="shortestPeriod" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="longestPeriod" minOccurs="0" maxOccurs="1" type="xs:double"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="CompositeTime">
    <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="year" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
            <xs:element name="month" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
            <xs:element name="day" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
            <xs:element name="hour" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
            <xs:element name="minute" minOccurs="0" maxOccurs="1" type="bed:IntegerQuantity"/>
            <xs:element name="second" minOccurs="0" maxOccurs="1" type="bed:RealQuantity"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Tensor">
    <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="Mrr" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
            <xs:element name="Mtt" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
            <xs:element name="Mpp" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
            <xs:element name="Mrt" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
            <xs:element name="Mrp" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
            <xs:element name="Mtp" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="OriginQuality">
    <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="associatedPhaseCount" minOccurs="0" maxOccurs="1" type="
                xs:integer"/>
            <xs:element name="usedPhaseCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
            <xs:element name="associatedStationCount" minOccurs="0" maxOccurs="1" type="
                xs:integer"/>
            <xs:element name="usedStationCount" minOccurs="0" maxOccurs="1" type="xs:integer"/
                >
            <xs:element name="depthPhaseCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
            <xs:element name="standardError" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="azimuthalGap" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="secondaryAzimuthalGap" minOccurs="0" maxOccurs="1" type="
                xs:double"/>
            <xs:element name="groundTruthLevel" minOccurs="0" maxOccurs="1">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="32"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="maximumDistance" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="minimumDistance" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="medianDistance" minOccurs="0" maxOccurs="1" type="xs:double"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
```

```
    </xs:complexType>
    <xs:complexType name="RealQuantity">
      <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
          <xs:element name="value" minOccurs="1" maxOccurs="1" type="xs:double"/>
          <xs:element name="uncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
          <xs:element name="lowerUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
          <xs:element name="upperUncertainty" minOccurs="0" maxOccurs="1" type="xs:double"/>
          <xs:element name="confidenceLevel" minOccurs="0" maxOccurs="1" type="xs:double"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
      </xs:sequence>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:complexType>
    <xs:complexType name="NodalPlane">
      <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
          <xs:element name="strike" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
          <xs:element name="dip" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
          <xs:element name="rake" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
      </xs:sequence>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:complexType>
    <xs:complexType name="TimeWindow">
      <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
          <xs:element name="begin" minOccurs="1" maxOccurs="1" type="xs:double"/>
          <xs:element name="end" minOccurs="1" maxOccurs="1" type="xs:double"/>
          <xs:element name="reference" minOccurs="1" maxOccurs="1" type="xs:dateTime"/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
      </xs:sequence>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:complexType>
    <xs:complexType name="WaveformStreamID">
      <xs:simpleContent>
        <xs:extension base="bed:ResourceReference_optional">
          <xs:attribute name="networkCode" use="required">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:maxLength value="8"/>
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
          <xs:attribute name="stationCode" use="required">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:maxLength value="8"/>
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
          <xs:attribute name="channelCode">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:maxLength value="8"/>
              </xs:restriction>
            </xs:simpleType>
          </xs:attribute>
          <xs:attribute name="locationCode">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:maxLength value="8"/>
              </xs:restriction>
```

```
        </xs:simpleType>
      </xs:attribute>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
    </xs:extension>
  </xs:simpleContent>
</xs:complexType>
<xs:complexType name="IntegerQuantity">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="value" minOccurs="1" maxOccurs="1" type="xs:integer"/>
      <xs:element name="uncertainty" minOccurs="0" maxOccurs="1" type="xs:integer"/>
      <xs:element name="lowerUncertainty" minOccurs="0" maxOccurs="1" type="xs:integer"/
            >
      <xs:element name="upperUncertainty" minOccurs="0" maxOccurs="1" type="xs:integer"/
            >
      <xs:element name="confidenceLevel" minOccurs="0" maxOccurs="1" type="xs:double"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="SourceTimeFunction">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="type" minOccurs="1" maxOccurs="1" type="
            bed:SourceTimeFunctionType"/>
      <xs:element name="duration" minOccurs="1" maxOccurs="1" type="xs:double"/>
      <xs:element name="riseTime" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="decayTime" minOccurs="0" maxOccurs="1" type="xs:double"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="NodalPlanes">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="nodalPlane1" minOccurs="0" maxOccurs="1" type="bed:NodalPlane"/>
      <xs:element name="nodalPlane2" minOccurs="0" maxOccurs="1" type="bed:NodalPlane"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:attribute name="preferredPlane" type="xs:integer"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="ConfidenceEllipsoid">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="semiMajorAxisLength" minOccurs="1" maxOccurs="1" type="xs:double
            "/>
      <xs:element name="semiMinorAxisLength" minOccurs="1" maxOccurs="1" type="xs:double
            "/>
      <xs:element name="semiIntermediateAxisLength" minOccurs="1" maxOccurs="1" type="
            xs:double"/>
      <xs:element name="majorAxisPlunge" minOccurs="1" maxOccurs="1" type="xs:double"/>
      <xs:element name="majorAxisAzimuth" minOccurs="1" maxOccurs="1" type="xs:double"/>
      <xs:element name="majorAxisRotation" minOccurs="1" maxOccurs="1" type="xs:double"/
            >
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Reading">
```

```
  <xs:sequence >
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="pickReference" type="bed:ResourceReference"/>
      <xs:element name="amplitudeReference" type="bed:ResourceReference"/>
    </xs:choice >
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
        "/>
  </xs:sequence >
  <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType >
<xs:complexType name="MomentTensor">
  <xs:sequence >
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="dataUsed" type="bed:DataUsed"/>
      <xs:element name="comment" type="bed:Comment"/>
      <xs:element name="derivedOriginID" minOccurs="1" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="momentMagnitudeID" minOccurs="0" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="scalarMoment" minOccurs="0" maxOccurs="1" type="bed:RealQuantity
          "/>
      <xs:element name="tensor" minOccurs="0" maxOccurs="1" type="bed:Tensor"/>
      <xs:element name="variance" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="varianceReduction" minOccurs="0" maxOccurs="1" type="xs:double"/
          >
      <xs:element name="doubleCouple" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="clvd" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="iso" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="greensFunctionID" minOccurs="0" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="filterID" minOccurs="0" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="sourceTimeFunction" minOccurs="0" maxOccurs="1" type="
          bed:SourceTimeFunction"/>
      <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="category" minOccurs="0" maxOccurs="1" type="
          bed:MomentTensorCategory"/>
      <xs:element name="inversionType" minOccurs="0" maxOccurs="1" type="
          bed:MTInversionType"/>
      <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
          "/>
    </xs:choice >
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
        "/>
  </xs:sequence >
  <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType >
<xs:complexType name="FocalMechanism">
  <xs:sequence >
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="waveformID" type="bed:WaveformStreamID"/>
      <xs:element name="comment" type="bed:Comment"/>
      <xs:element name="momentTensor" type="bed:MomentTensor"/>
      <xs:element name="triggeringOriginID" minOccurs="0" maxOccurs="1" type="
          bed:ResourceReference"/>
      <xs:element name="nodalPlanes" minOccurs="0" maxOccurs="1" type="bed:NodalPlanes"/
          >
      <xs:element name="principalAxes" minOccurs="0" maxOccurs="1" type="
          bed:PrincipalAxes"/>
      <xs:element name="azimuthalGap" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="stationPolarityCount" minOccurs="0" maxOccurs="1" type="xs:int"/
          >
      <xs:element name="misfit" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="stationDistributionRatio" minOccurs="0" maxOccurs="1" type="
          xs:double"/>
```

```
            <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
                bed:ResourceReference"/>
            <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
                "/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Amplitude">
    <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="comment" type="bed:Comment"/>
            <xs:element name="genericAmplitude" minOccurs="1" maxOccurs="1" type="
                bed:RealQuantity"/>
            <xs:element name="type" minOccurs="0" maxOccurs="1">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="32"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="category" minOccurs="0" maxOccurs="1" type="
                bed:AmplitudeCategory"/>
            <xs:element name="unit" minOccurs="0" maxOccurs="1" type="bed:AmplitudeUnit"/>
            <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
                bed:ResourceReference"/>
            <xs:element name="period" minOccurs="0" maxOccurs="1" type="bed:RealQuantity"/>
            <xs:element name="snr" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="timeWindow" minOccurs="0" maxOccurs="1" type="bed:TimeWindow"/>
            <xs:element name="pickID" minOccurs="0" maxOccurs="1" type="bed:ResourceReference"
                />
            <xs:element name="waveformID" minOccurs="0" maxOccurs="1" type="
                bed:WaveformStreamID"/>
            <xs:element name="filterID" minOccurs="0" maxOccurs="1" type="
                bed:ResourceReference"/>
            <xs:element name="scalingTime" minOccurs="0" maxOccurs="1" type="bed:TimeQuantity"
                />
            <xs:element name="magnitudeHint" minOccurs="0" maxOccurs="1">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:maxLength value="32"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:element>
            <xs:element name="evaluationMode" minOccurs="0" maxOccurs="1" type="
                bed:EvaluationMode"/>
            <xs:element name="evaluationStatus" minOccurs="0" maxOccurs="1" type="
                bed:EvaluationStatus"/>
            <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
                "/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
    </xs:sequence>
    <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="StationMagnitudeContribution">
    <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="stationMagnitudeID" minOccurs="1" maxOccurs="1" type="
                bed:ResourceReference"/>
            <xs:element name="residual" minOccurs="0" maxOccurs="1" type="xs:double"/>
            <xs:element name="weight" minOccurs="0" maxOccurs="1" type="xs:double"/>
        </xs:choice>
```

```
          <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
              "/>
      </xs:sequence>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="Magnitude">
      <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
          <xs:element name="comment" type="bed:Comment"/>
          <xs:element name="stationMagnitudeContribution" type="
              bed:StationMagnitudeContribution"/>
          <xs:element name="mag" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
          <xs:element name="type" minOccurs="0" maxOccurs="1">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:maxLength value="32"/>
              </xs:restriction>
            </xs:simpleType>
          </xs:element>
          <xs:element name="originID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="stationCount" minOccurs="0" maxOccurs="1" type="xs:integer"/>
          <xs:element name="azimuthalGap" minOccurs="0" maxOccurs="1" type="xs:double"/>
          <xs:element name="evaluationMode" minOccurs="0" maxOccurs="1" type="
              bed:EvaluationMode"/>
          <xs:element name="evaluationStatus" minOccurs="0" maxOccurs="1" type="
              bed:EvaluationStatus"/>
          <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
              "/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
      </xs:sequence>
      <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="StationMagnitude">
      <xs:sequence>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
          <xs:element name="comment" type="bed:Comment"/>
          <xs:element name="originID" minOccurs="1" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="mag" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
          <xs:element name="type" minOccurs="0" maxOccurs="1">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:maxLength value="32"/>
              </xs:restriction>
            </xs:simpleType>
          </xs:element>
          <xs:element name="amplitudeID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
              bed:ResourceReference"/>
          <xs:element name="waveformID" minOccurs="0" maxOccurs="1" type="
              bed:WaveformStreamID"/>
          <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
              "/>
        </xs:choice>
        <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
            "/>
      </xs:sequence>
      <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
      <xs:anyAttribute namespace="##other" processContents="lax"/>
  </xs:complexType>
  <xs:complexType name="Pick">
```

```xml
<xs:sequence >
  <xs:choice minOccurs ="0" maxOccurs ="unbounded">
    <xs:element name="comment" type="bed:Comment"/>
    <xs:element name="time" minOccurs ="1" maxOccurs ="1" type="bed:TimeQuantity"/>
    <xs:element name="waveformID" minOccurs ="1" maxOccurs ="1" type="
        bed:WaveformStreamID"/>
    <xs:element name="filterID" minOccurs ="0" maxOccurs ="1" type="
        bed:ResourceReference"/>
    <xs:element name="methodID" minOccurs ="0" maxOccurs ="1" type="
        bed:ResourceReference"/>
    <xs:element name="horizontalSlowness" minOccurs ="0" maxOccurs ="1" type="
        bed:RealQuantity"/>
    <xs:element name="backazimuth" minOccurs ="0" maxOccurs ="1" type="bed:RealQuantity"
        />
    <xs:element name="slownessMethodID" minOccurs ="0" maxOccurs ="1" type="
        bed:ResourceReference"/>
    <xs:element name="onset" minOccurs ="0" maxOccurs ="1" type="bed:PickOnset"/>
    <xs:element name="phaseHint" minOccurs ="0" maxOccurs ="1" type="bed:Phase"/>
    <xs:element name="polarity" minOccurs ="0" maxOccurs ="1" type="bed:PickPolarity"/>
    <xs:element name="evaluationMode" minOccurs ="0" maxOccurs ="1" type="
        bed:EvaluationMode"/>
    <xs:element name="evaluationStatus" minOccurs ="0" maxOccurs ="1" type="
        bed:EvaluationStatus"/>
    <xs:element name="creationInfo" minOccurs ="0" maxOccurs ="1" type="bed:CreationInfo
        "/>
  </xs:choice>
  <xs:any namespace="##other" processContents="lax" minOccurs ="0" maxOccurs ="unbounded
      "/>
</xs:sequence >
<xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
<xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Event">
  <xs:sequence >
    <xs:choice minOccurs ="0" maxOccurs ="unbounded">
      <xs:element name="originReference" type="bed:ResourceReference"/>
      <xs:element name="magnitudeReference" type="bed:ResourceReference"/>
      <xs:element name="focalMechanismReference" type="bed:ResourceReference"/>
      <xs:element name="description" type="bed:EventDescription"/>
      <xs:element name="comment" type="bed:Comment"/>
      <xs:element name="preferredOriginID" minOccurs ="0" maxOccurs ="1" type="
          bed:ResourceReference"/>
      <xs:element name="preferredMagnitudeID" minOccurs ="0" maxOccurs ="1" type="
          bed:ResourceReference"/>
      <xs:element name="preferredFocalMechanismID" minOccurs ="0" maxOccurs ="1" type="
          bed:ResourceReference"/>
      <xs:element name="type" minOccurs ="0" maxOccurs ="1" type="bed:EventType"/>
      <xs:element name="typeCertainty" minOccurs ="0" maxOccurs ="1" type="
          bed:EventTypeCertainty"/>
      <xs:element name="creationInfo" minOccurs ="0" maxOccurs ="1" type="bed:CreationInfo
          "/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs ="0" maxOccurs ="unbounded
        "/>
  </xs:sequence >
  <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="OriginUncertainty">
  <xs:sequence >
    <xs:choice minOccurs ="0" maxOccurs ="unbounded">
      <xs:element name="horizontalUncertainty" minOccurs ="0" maxOccurs ="1" type="
          xs:double"/>
      <xs:element name="minHorizontalUncertainty" minOccurs ="0" maxOccurs ="1" type="
          xs:double"/>
      <xs:element name="maxHorizontalUncertainty" minOccurs ="0" maxOccurs ="1" type="
          xs:double"/>
```

```xml
      <xs:element name="azimuthMaxHorizontalUncertainty" minOccurs="0" maxOccurs="1"
            type="xs:double"/>
      <xs:element name="confidenceEllipsoid" minOccurs="0" maxOccurs="1" type="
            bed:ConfidenceEllipsoid"/>
      <xs:element name="preferredDescription" minOccurs="0" maxOccurs="1" type="
            bed:OriginUncertaintyDescription"/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Arrival">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="comment" type="bed:Comment"/>
      <xs:element name="pickID" minOccurs="1" maxOccurs="1" type="bed:ResourceReference"
            />
      <xs:element name="phase" minOccurs="1" maxOccurs="1" type="bed:Phase"/>
      <xs:element name="timeCorrection" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="azimuth" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="distance" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="takeoffAngle" minOccurs="0" maxOccurs="1" type="bed:RealQuantity
            "/>
      <xs:element name="timeResidual" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="horizontalSlownessResidual" minOccurs="0" maxOccurs="1" type="
            xs:double"/>
      <xs:element name="backazimuthResidual" minOccurs="0" maxOccurs="1" type="xs:double
            "/>
      <xs:element name="timeWeight" minOccurs="0" maxOccurs="1" type="xs:double"/>
      <xs:element name="horizontalSlownessWeight" minOccurs="0" maxOccurs="1" type="
            xs:double"/>
      <xs:element name="backazimuthWeight" minOccurs="0" maxOccurs="1" type="xs:double"/
            >
      <xs:element name="earthModelID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
            "/>
    </xs:choice>
    <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
          "/>
  </xs:sequence>
  <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Origin">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="compositeTime" type="bed:CompositeTime"/>
      <xs:element name="comment" type="bed:Comment"/>
      <xs:element name="originUncertainty" type="bed:OriginUncertainty"/>
      <xs:element name="arrival" type="bed:Arrival"/>
      <xs:element name="time" minOccurs="1" maxOccurs="1" type="bed:TimeQuantity"/>
      <xs:element name="longitude" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="latitude" minOccurs="1" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="depth" minOccurs="0" maxOccurs="1" type="bed:RealQuantity"/>
      <xs:element name="depthType" minOccurs="0" maxOccurs="1" type="bed:OriginDepthType
            "/>
      <xs:element name="timeFixed" minOccurs="0" maxOccurs="1" type="xs:boolean"/>
      <xs:element name="epicenterFixed" minOccurs="0" maxOccurs="1" type="xs:boolean"/>
      <xs:element name="referenceSystemID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="earthModelID" minOccurs="0" maxOccurs="1" type="
            bed:ResourceReference"/>
      <xs:element name="quality" minOccurs="0" maxOccurs="1" type="bed:OriginQuality"/>
      <xs:element name="type" minOccurs="0" maxOccurs="1" type="bed:OriginType"/>
```

```xml
                  <xs:element name="region" minOccurs="0" maxOccurs="1">
                    <xs:simpleType>
                      <xs:restriction base="xs:string">
                        <xs:maxLength value="128"/>
                      </xs:restriction>
                    </xs:simpleType>
                  </xs:element>
                  <xs:element name="evaluationMode" minOccurs="0" maxOccurs="1" type="
                          bed:EvaluationMode"/>
                  <xs:element name="evaluationStatus" minOccurs="0" maxOccurs="1" type="
                          bed:EvaluationStatus"/>
                  <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
                          "/>
                </xs:choice>
                <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
                        "/>
              </xs:sequence>
              <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
              <xs:anyAttribute namespace="##other" processContents="lax"/>
          </xs:complexType>
          <xs:complexType name="EventParameters">
            <xs:sequence>
              <xs:choice minOccurs="0" maxOccurs="unbounded">
                <xs:element name="comment" type="bed:Comment"/>
                <xs:element name="reading" type="bed:Reading"/>
                <xs:element name="focalMechanism" type="bed:FocalMechanism"/>
                <xs:element name="amplitude" type="bed:Amplitude"/>
                <xs:element name="magnitude" type="bed:Magnitude"/>
                <xs:element name="stationMagnitude" type="bed:StationMagnitude"/>
                <xs:element name="pick" type="bed:Pick"/>
                <xs:element name="event" type="bed:Event"/>
                <xs:element name="origin" type="bed:Origin"/>
                <xs:element name="description" minOccurs="0" maxOccurs="1" type="xs:string"/>
                <xs:element name="creationInfo" minOccurs="0" maxOccurs="1" type="bed:CreationInfo
                        "/>
              </xs:choice>
              <xs:any namespace="##other" processContents="lax" minOccurs="0" maxOccurs="unbounded
                      "/>
            </xs:sequence>
            <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
            <xs:anyAttribute namespace="##other" processContents="lax"/>
          </xs:complexType>
          <xs:element name="eventParameters" type="bed:EventParameters"/>
      </xs:schema>
```

B. QuakeML—Relax NG Description

In this Section the Relax NG descriptions for QuakeML BED and QuakeML BED-RT, version 1.2, are listed. The schemas can also be found online[12].

B.1. QuakeML BED, Version 1.2

B.1.1. Umbrella Schema (QuakeML-1.2.rng)

```
<?xml version="1.0" encoding="UTF-8"?>
<rng:grammar ns="http://quakeml.org/xmlns/quakeml/1.2"
             xmlns:bed="http://quakeml.org/xmlns/bed/1.2"
             xmlns:rng="http://relaxng.org/ns/structure/1.0"
             datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">

    <rng:include href="QuakeML-BED-1.2.rng"/>

    <!-- wildcard definitions
         see: Eric van der Vlist, Relax NG, O'Reilly & Associates (ISBN: 0596004214)
              http://books.xmlschemata.org/relaxng/

         excluded namespaces: empty namespace, umbrella schema and all included schemas
                -->

    <rng:define name="anything">
        <rng:zeroOrMore>
            <rng:choice>
                <rng:element>
                    <rng:anyName/>
                    <rng:ref name="anything"/>
                </rng:element>
                <rng:attribute>
                    <rng:anyName/>
                </rng:attribute>
                <rng:text/>
            </rng:choice>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="foreign-elements">
        <rng:zeroOrMore>
            <rng:element>
                <rng:anyName>
                    <rng:except>
                        <rng:nsName ns=""/>
                        <rng:nsName ns="http://quakeml.org/xmlns/quakeml-rt/1.2"/>
                        <rng:nsName ns="http://quakeml.org/xmlns/bed-rt/1.2"/>
                    </rng:except>
                </rng:anyName>
                <rng:ref name="anything"/>
            </rng:element>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="foreign-attributes">
        <rng:zeroOrMore>
            <rng:attribute>
                <rng:anyName>
                    <rng:except>
```

---

[12]BED: http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-1.2.rng, http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-BED-1.2.rng, BED-RT: http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-RT-1.2.rng, http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-RT-BED-1.2.rng.

```
                        <rng:nsName ns=""/>
                        <rng:nsName ns="http://quakeml.org/xmlns/quakeml-rt/1.2"/>
                        <rng:nsName ns="http://quakeml.org/xmlns/bed-rt/1.2"/>
                    </rng:except>
                </rng:anyName>
            </rng:attribute>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="foreign-nodes">
        <rng:zeroOrMore>
            <rng:choice>
                <rng:ref name="foreign-attributes"/>
                <rng:ref name="foreign-elements"/>
            </rng:choice>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="Quakeml">
        <rng:optional>
            <rng:element name="bed:eventParameters">
                <rng:ref name="EventParameters"/>
            </rng:element>
        </rng:optional>
        <rng:ref name="foreign-nodes"/>
    </rng:define>

    <rng:start>
        <rng:element name="quakeml">
            <rng:ref name="Quakeml"/>
        </rng:element>
    </rng:start>

</rng:grammar>
```

B.1.2. Basic Event Description Package (QuakeML-BED-1.2.rng)

```
<?xml version="1.0"?>
<rng:grammar xmlns:rng="http://relaxng.org/ns/structure/1.0" xmlns:bed="http://quakeml.org
        /xmlns/bed/1.2" xmlns="http://quakeml.org/xmlns/bed/1.2" ns="http://quakeml.org/
        xmlns/bed/1.2" datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">
  <rng:define name="eventParameters_anything">
    <rng:zeroOrMore>
      <rng:choice>
        <rng:element>
          <rng:anyName/>
          <rng:ref name="eventParameters_anything"/>
        </rng:element>
        <rng:attribute>
          <rng:anyName/>
        </rng:attribute>
        <rng:text/>
      </rng:choice>
    </rng:zeroOrMore>
  </rng:define>
  <rng:define name="eventParameters_foreign-elements">
    <rng:zeroOrMore>
      <rng:element>
        <rng:anyName>
          <rng:except>
            <rng:nsName ns=""/>
            <rng:nsName ns="http://quakeml.org/xmlns/bed/1.2"/>
          </rng:except>
        </rng:anyName>
        <rng:ref name="eventParameters_anything"/>
      </rng:element>
    </rng:zeroOrMore>
```

```
    </rng:define>
    <rng:define name="eventParameters_foreign-attributes">
      <rng:zeroOrMore>
        <rng:attribute>
          <rng:anyName>
            <rng:except>
              <rng:nsName ns=""/>
              <rng:nsName ns="http://quakeml.org/xmlns/bed/1.2"/>
            </rng:except>
          </rng:anyName>
        </rng:attribute>
      </rng:zeroOrMore>
    </rng:define>
    <rng:define name="eventParameters_foreign-nodes">
      <rng:zeroOrMore>
        <rng:choice>
          <rng:ref name="eventParameters_foreign-attributes"/>
          <rng:ref name="eventParameters_foreign-elements"/>
        </rng:choice>
      </rng:zeroOrMore>
    </rng:define>
    <rng:define name="ResourceIdentifier">
      <rng:data type="anyURI">
        <rng:param name="pattern">(smi|quakeml):[\w\d][\w\d\-\.\*\(\)_~']{2,}/[\w\d
        \-\.\*\(\)_~'][\w\d\-\.\*\(\)\+\?_~'=,;#/&amp;]*</rng:param>
      </rng:data>
    </rng:define>
    <rng:define name="OriginUncertaintyDescription">
      <rng:choice>
        <rng:value type="string">horizontal uncertainty</rng:value>
        <rng:value type="string">uncertainty ellipse</rng:value>
        <rng:value type="string">confidence ellipsoid</rng:value>
      </rng:choice>
    </rng:define>
    <rng:define name="AmplitudeCategory">
      <rng:choice>
        <rng:value type="string">point</rng:value>
        <rng:value type="string">mean</rng:value>
        <rng:value type="string">duration</rng:value>
        <rng:value type="string">period</rng:value>
        <rng:value type="string">integral</rng:value>
        <rng:value type="string">other</rng:value>
      </rng:choice>
    </rng:define>
    <rng:define name="OriginDepthType">
      <rng:choice>
        <rng:value type="string">from location</rng:value>
        <rng:value type="string">from moment tensor inversion</rng:value>
        <rng:value type="string">from modeling of broad-band P waveforms</rng:value>
        <rng:value type="string">constrained by depth phases</rng:value>
        <rng:value type="string">constrained by direct phases</rng:value>
        <rng:value type="string">constrained by depth and direct phases</rng:value>
        <rng:value type="string">operator assigned</rng:value>
        <rng:value type="string">other</rng:value>
      </rng:choice>
    </rng:define>
    <rng:define name="OriginType">
      <rng:choice>
        <rng:value type="string">hypocenter</rng:value>
        <rng:value type="string">centroid</rng:value>
        <rng:value type="string">amplitude</rng:value>
        <rng:value type="string">macroseismic</rng:value>
        <rng:value type="string">rupture start</rng:value>
        <rng:value type="string">rupture end</rng:value>
      </rng:choice>
    </rng:define>
    <rng:define name="MTInversionType">
      <rng:choice>
```

```xml
        <rng:value type="string">general</rng:value>
        <rng:value type="string">zero trace</rng:value>
        <rng:value type="string">double couple</rng:value>
      </rng:choice>
  </rng:define>
  <rng:define name="EvaluationMode">
    <rng:choice>
      <rng:value type="string">manual</rng:value>
      <rng:value type="string">automatic</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="EvaluationStatus">
    <rng:choice>
      <rng:value type="string">preliminary</rng:value>
      <rng:value type="string">confirmed</rng:value>
      <rng:value type="string">reviewed</rng:value>
      <rng:value type="string">final</rng:value>
      <rng:value type="string">rejected</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="PickOnset">
    <rng:choice>
      <rng:value type="string">emergent</rng:value>
      <rng:value type="string">impulsive</rng:value>
      <rng:value type="string">questionable</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="EventType">
    <rng:choice>
      <rng:value type="string">not existing</rng:value>
      <rng:value type="string">not reported</rng:value>
      <rng:value type="string">earthquake</rng:value>
      <rng:value type="string">anthropogenic event</rng:value>
      <rng:value type="string">collapse</rng:value>
      <rng:value type="string">cavity collapse</rng:value>
      <rng:value type="string">mine collapse</rng:value>
      <rng:value type="string">building collapse</rng:value>
      <rng:value type="string">explosion</rng:value>
      <rng:value type="string">accidental explosion</rng:value>
      <rng:value type="string">chemical explosion</rng:value>
      <rng:value type="string">controlled explosion</rng:value>
      <rng:value type="string">experimental explosion</rng:value>
      <rng:value type="string">industrial explosion</rng:value>
      <rng:value type="string">mining explosion</rng:value>
      <rng:value type="string">quarry blast</rng:value>
      <rng:value type="string">road cut</rng:value>
      <rng:value type="string">blasting levee</rng:value>
      <rng:value type="string">nuclear explosion</rng:value>
      <rng:value type="string">induced or triggered event</rng:value>
      <rng:value type="string">rock burst</rng:value>
      <rng:value type="string">reservoir loading</rng:value>
      <rng:value type="string">fluid injection</rng:value>
      <rng:value type="string">fluid extraction</rng:value>
      <rng:value type="string">crash</rng:value>
      <rng:value type="string">plane crash</rng:value>
      <rng:value type="string">train crash</rng:value>
      <rng:value type="string">boat crash</rng:value>
      <rng:value type="string">other event</rng:value>
      <rng:value type="string">atmospheric event</rng:value>
      <rng:value type="string">sonic boom</rng:value>
      <rng:value type="string">sonic blast</rng:value>
      <rng:value type="string">acoustic noise</rng:value>
      <rng:value type="string">thunder</rng:value>
      <rng:value type="string">avalanche</rng:value>
      <rng:value type="string">snow avalanche</rng:value>
      <rng:value type="string">debris avalanche</rng:value>
      <rng:value type="string">hydroacoustic event</rng:value>
      <rng:value type="string">ice quake</rng:value>
```

```
        <rng:value type="string">slide</rng:value>
        <rng:value type="string">landslide</rng:value>
        <rng:value type="string">rockslide</rng:value>
        <rng:value type="string">meteorite</rng:value>
        <rng:value type="string">volcanic eruption</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="DataUsedWaveType">
    <rng:choice>
        <rng:value type="string">P waves</rng:value>
        <rng:value type="string">body waves</rng:value>
        <rng:value type="string">surface waves</rng:value>
        <rng:value type="string">mantle waves</rng:value>
        <rng:value type="string">combined</rng:value>
        <rng:value type="string">unknown</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="AmplitudeUnit">
    <rng:choice>
        <rng:value type="string">m</rng:value>
        <rng:value type="string">s</rng:value>
        <rng:value type="string">m/s</rng:value>
        <rng:value type="string">m/(s*s)</rng:value>
        <rng:value type="string">m*s</rng:value>
        <rng:value type="string">dimensionless</rng:value>
        <rng:value type="string">other</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="EventDescriptionType">
    <rng:choice>
        <rng:value type="string">felt report</rng:value>
        <rng:value type="string">Flinn-Engdahl region</rng:value>
        <rng:value type="string">local time</rng:value>
        <rng:value type="string">tectonic summary</rng:value>
        <rng:value type="string">nearest cities</rng:value>
        <rng:value type="string">earthquake name</rng:value>
        <rng:value type="string">region name</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="MomentTensorCategory">
    <rng:choice>
        <rng:value type="string">teleseismic</rng:value>
        <rng:value type="string">regional</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="EventTypeCertainty">
    <rng:choice>
        <rng:value type="string">known</rng:value>
        <rng:value type="string">suspected</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="SourceTimeFunctionType">
    <rng:choice>
        <rng:value type="string">box car</rng:value>
        <rng:value type="string">triangle</rng:value>
        <rng:value type="string">trapezoid</rng:value>
        <rng:value type="string">unknown</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="PickPolarity">
    <rng:choice>
        <rng:value type="string">positive</rng:value>
        <rng:value type="string">negative</rng:value>
        <rng:value type="string">undecidable</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="TimeQuantity">
    <rng:interleave>
```

```
        <rng:element name="value">
          <rng:data type="dateTime"/>
        </rng:element>
        <rng:optional>
          <rng:element name="uncertainty">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="lowerUncertainty">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="upperUncertainty">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="confidenceLevel">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
    </rng:define>
    <rng:define name="ResourceReference">
      <rng:ref name="ResourceIdentifier"/>
    </rng:define>
    <rng:define name="CreationInfo">
      <rng:interleave>
        <rng:optional>
          <rng:element name="agencyID">
            <rng:data type="string">
              <rng:param name="maxLength">64</rng:param>
            </rng:data>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="agencyURI">
            <rng:ref name="ResourceReference"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="author">
            <rng:data type="string">
              <rng:param name="maxLength">128</rng:param>
            </rng:data>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="authorURI">
            <rng:ref name="ResourceReference"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="creationTime">
            <rng:data type="dateTime"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="version">
            <rng:data type="string">
              <rng:param name="maxLength">64</rng:param>
            </rng:data>
          </rng:element>
        </rng:optional>
```

```
      </rng:interleave >
      <rng:ref name="eventParameters_foreign -elements"/>
      <rng:ref name="eventParameters_foreign -attributes"/>
    </rng:define >
    <rng:define name="EventDescription">
      <rng:interleave >
        <rng:element name="text">
          <rng:data type="string"/>
        </rng:element >
        <rng:optional >
          <rng:element name="type">
            <rng:ref name="EventDescriptionType"/>
          </rng:element >
        </rng:optional >
      </rng:interleave >
      <rng:ref name="eventParameters_foreign -elements"/>
      <rng:ref name="eventParameters_foreign -attributes"/>
    </rng:define >
    <rng:define name="Phase">
      <rng:data type="string">
        <rng:param name="maxLength">32</rng:param >
      </rng:data >
      <rng:ref name="eventParameters_foreign -attributes"/>
    </rng:define >
    <rng:define name="Comment">
      <rng:interleave >
        <rng:element name="text">
          <rng:data type="string"/>
        </rng:element >
        <rng:optional >
          <rng:element name="creationInfo">
            <rng:ref name="CreationInfo"/>
          </rng:element >
        </rng:optional >
      </rng:interleave >
      <rng:ref name="eventParameters_foreign -elements"/>
      <rng:optional >
        <rng:attribute name="id">
          <rng:ref name="ResourceReference"/>
        </rng:attribute >
      </rng:optional >
      <rng:ref name="eventParameters_foreign -attributes"/>
    </rng:define >
    <rng:define name="Axis">
      <rng:interleave >
        <rng:element name="azimuth">
          <rng:ref name="RealQuantity"/>
        </rng:element >
        <rng:element name="plunge">
          <rng:ref name="RealQuantity"/>
        </rng:element >
        <rng:element name="length">
          <rng:ref name="RealQuantity"/>
        </rng:element >
      </rng:interleave >
      <rng:ref name="eventParameters_foreign -elements"/>
      <rng:ref name="eventParameters_foreign -attributes"/>
    </rng:define >
    <rng:define name="PrincipalAxes">
      <rng:interleave >
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          <rng:ref name="Axis"/>
        </rng:element >
        <rng:element name="pAxis">
          <rng:ref name="Axis"/>
        </rng:element >
        <rng:optional >
          <rng:element name="nAxis">
```

```
          <rng:ref name="Axis"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="DataUsed">
    <rng:interleave>
      <rng:element name="waveType">
        <rng:ref name="DataUsedWaveType"/>
      </rng:element>
      <rng:optional>
        <rng:element name="stationCount">
          <rng:data type="integer"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="componentCount">
          <rng:data type="integer"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="shortestPeriod">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="longestPeriod">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="CompositeTime">
    <rng:interleave>
      <rng:optional>
        <rng:element name="year">
          <rng:ref name="IntegerQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="month">
          <rng:ref name="IntegerQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="day">
          <rng:ref name="IntegerQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="hour">
          <rng:ref name="IntegerQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="minute">
          <rng:ref name="IntegerQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="second">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:optional>
```

```
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="Tensor">
      <rng:interleave>
        <rng:element name="Mrr">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mtt">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mpp">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mrt">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mrp">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mtp">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="OriginQuality">
      <rng:interleave>
        <rng:optional>
          <rng:element name="associatedPhaseCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="usedPhaseCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="associatedStationCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="usedStationCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="depthPhaseCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="standardError">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="azimuthalGap">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="secondaryAzimuthalGap">
            <rng:data type="double"/>
```

```
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" groundTruthLevel ">
              <rng:data  type =" string ">
                <rng:param  name =" maxLength ">32 </rng:param >
              </rng:data >
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" maximumDistance ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" minimumDistance ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" medianDistance ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
        </rng:interleave >
        <rng:ref  name =" eventParameters_foreign - elements "/>
        <rng:ref  name =" eventParameters_foreign - attributes "/>
      </rng:define >
      <rng:define  name =" RealQuantity ">
        <rng:interleave >
          <rng:element  name =" value ">
            <rng:data  type =" double "/>
          </rng:element >
          <rng:optional >
            <rng:element  name =" uncertainty ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" lowerUncertainty ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" upperUncertainty ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name =" confidenceLevel ">
              <rng:data  type =" double "/>
            </rng:element >
          </rng:optional >
        </rng:interleave >
        <rng:ref  name =" eventParameters_foreign - elements "/>
        <rng:ref  name =" eventParameters_foreign - attributes "/>
      </rng:define >
      <rng:define  name =" NodalPlane ">
        <rng:interleave >
          <rng:element  name =" strike ">
            <rng:ref  name =" RealQuantity "/>
          </rng:element >
          <rng:element  name =" dip ">
            <rng:ref  name =" RealQuantity "/>
          </rng:element >
          <rng:element  name =" rake ">
            <rng:ref  name =" RealQuantity "/>
          </rng:element >
```

```
      </rng:interleave >
      <rng:ref  name="eventParameters_foreign -elements "/>
      <rng:ref  name="eventParameters_foreign -attributes "/>
    </rng:define >
    <rng:define  name="TimeWindow ">
      <rng:interleave >
        <rng:element  name="begin">
          <rng:data  type="double"/>
        </rng:element >
        <rng:element  name="end">
          <rng:data  type="double"/>
        </rng:element >
        <rng:element  name="reference ">
          <rng:data  type="dateTime "/>
        </rng:element >
      </rng:interleave >
      <rng:ref  name="eventParameters_foreign -elements "/>
      <rng:ref  name="eventParameters_foreign -attributes "/>
    </rng:define >
    <rng:define  name="WaveformStreamID ">
      <rng:optional >
        <rng:ref  name="ResourceReference "/>
      </rng:optional >
      <rng:attribute  name="networkCode ">
        <rng:data  type="string">
          <rng:param  name="maxLength ">8</rng:param >
        </rng:data >
      </rng:attribute >
      <rng:attribute  name="stationCode ">
        <rng:data  type="string">
          <rng:param  name="maxLength ">8</rng:param >
        </rng:data >
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```xml
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        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:attribute name="publicID">
      <rng:ref name="ResourceReference"/>
    </rng:attribute>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="Pick">
    <rng:interleave>
      <rng:zeroOrMore>
        <rng:element name="comment">
          <rng:ref name="Comment"/>
        </rng:element>
      </rng:zeroOrMore>
      <rng:element name="time">
        <rng:ref name="TimeQuantity"/>
      </rng:element>
      <rng:element name="waveformID">
        <rng:ref name="WaveformStreamID"/>
      </rng:element>
      <rng:optional>
        <rng:element name="filterID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="methodID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="horizontalSlowness">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="backazimuth">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="slownessMethodID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="onset">
          <rng:ref name="PickOnset"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="phaseHint">
          <rng:ref name="Phase"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="polarity">
          <rng:ref name="PickPolarity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="evaluationMode">
          <rng:ref name="EvaluationMode"/>
        </rng:element>
      </rng:optional>
```

```
          <rng:optional >
            <rng:element  name="evaluationStatus">
              <rng:ref  name="EvaluationStatus"/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name="creationInfo">
              <rng:ref  name="CreationInfo"/>
            </rng:element >
          </rng:optional >
        </rng:interleave >
        <rng:ref  name="eventParameters_foreign -elements"/>
        <rng:attribute  name="publicID">
          <rng:ref  name="ResourceReference"/>
        </rng:attribute >
        <rng:ref  name="eventParameters_foreign -attributes"/>
      </rng:define >
      <rng:define  name="Event">
        <rng:interleave >
          <rng:zeroOrMore >
            <rng:element  name="description">
              <rng:ref  name="EventDescription"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="comment">
              <rng:ref  name="Comment"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="focalMechanism">
              <rng:ref  name="FocalMechanism"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="amplitude">
              <rng:ref  name="Amplitude"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="magnitude">
              <rng:ref  name="Magnitude"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="stationMagnitude">
              <rng:ref  name="StationMagnitude"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="origin">
              <rng:ref  name="Origin"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:zeroOrMore >
            <rng:element  name="pick">
              <rng:ref  name="Pick"/>
            </rng:element >
          </rng:zeroOrMore >
          <rng:optional >
            <rng:element  name="preferredOriginID">
              <rng:ref  name="ResourceReference"/>
            </rng:element >
          </rng:optional >
          <rng:optional >
            <rng:element  name="preferredMagnitudeID">
              <rng:ref  name="ResourceReference"/>
            </rng:element >
```

```
      </rng:optional >
      <rng:optional >
        <rng:element  name="preferredFocalMechanismID">
          <rng:ref  name="ResourceReference"/>
        </rng:element >
      </rng:optional >
      <rng:optional >
        <rng:element  name="type">
          <rng:ref  name="EventType"/>
        </rng:element >
      </rng:optional >
      <rng:optional >
        <rng:element  name="typeCertainty">
          <rng:ref  name="EventTypeCertainty"/>
        </rng:element >
      </rng:optional >
      <rng:optional >
        <rng:element  name="creationInfo">
          <rng:ref  name="CreationInfo"/>
        </rng:element >
      </rng:optional >
    </rng:interleave >
    <rng:ref  name="eventParameters_foreign -elements"/>
    <rng:attribute  name="publicID">
      <rng:ref  name="ResourceReference"/>
    </rng:attribute >
    <rng:ref  name="eventParameters_foreign -attributes"/>
  </rng:define >
  <rng:define  name="EventParameters">
    <rng:interleave >
      <rng:zeroOrMore >
        <rng:element  name="comment">
          <rng:ref  name="Comment"/>
        </rng:element >
      </rng:zeroOrMore >
      <rng:zeroOrMore >
        <rng:element  name="event">
          <rng:ref  name="Event"/>
        </rng:element >
      </rng:zeroOrMore >
      <rng:optional >
        <rng:element  name="description">
          <rng:data  type="string"/>
        </rng:element >
      </rng:optional >
      <rng:optional >
        <rng:element  name="creationInfo">
          <rng:ref  name="CreationInfo"/>
        </rng:element >
      </rng:optional >
    </rng:interleave >
    <rng:ref  name="eventParameters_foreign -elements"/>
    <rng:attribute  name="publicID">
      <rng:ref  name="ResourceReference"/>
    </rng:attribute >
    <rng:ref  name="eventParameters_foreign -attributes"/>
  </rng:define >
</rng:grammar >
```

B.2. QuakeML BED-RT, Version 1.2

B.2.1. Umbrella Schema (QuakeML-RT-1.2.rng)

```xml
<?xml version="1.0" encoding="UTF-8"?>
<rng:grammar ns="http://quakeml.org/xmlns/quakeml-rt/1.2"
             xmlns:bed="http://quakeml.org/xmlns/bed-rt/1.2"
             xmlns:rng="http://relaxng.org/ns/structure/1.0"
             datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">

    <rng:include href="QuakeML-RT-BED-1.2.rng"/>

    <!-- wildcard definitions
         see: Eric van der Vlist, Relax NG, O'Reilly & Associates (ISBN: 0596004214)
               http://books.xmlschemata.org/relaxng/

         excluded namespaces: empty namespace, umbrella schema and all included schemas
              -->

    <rng:define name="anything">
        <rng:zeroOrMore>
            <rng:choice>
                <rng:element>
                    <rng:anyName/>
                    <rng:ref name="anything"/>
                </rng:element>
                <rng:attribute>
                    <rng:anyName/>
                </rng:attribute>
                <rng:text/>
            </rng:choice>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="foreign-elements">
        <rng:zeroOrMore>
            <rng:element>
                <rng:anyName>
                    <rng:except>
                        <rng:nsName ns=""/>
                        <rng:nsName ns="http://quakeml.org/xmlns/quakeml-rt/1.2"/>
                        <rng:nsName ns="http://quakeml.org/xmlns/bed-rt/1.2"/>
                    </rng:except>
                </rng:anyName>
                <rng:ref name="anything"/>
            </rng:element>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="foreign-attributes">
        <rng:zeroOrMore>
            <rng:attribute>
                <rng:anyName>
                    <rng:except>
                        <rng:nsName ns=""/>
                        <rng:nsName ns="http://quakeml.org/xmlns/quakeml-rt/1.2"/>
                        <rng:nsName ns="http://quakeml.org/xmlns/bed-rt/1.2"/>
                    </rng:except>
                </rng:anyName>
            </rng:attribute>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="foreign-nodes">
        <rng:zeroOrMore>
            <rng:choice>
                <rng:ref name="foreign-attributes"/>
```

```
                <rng:ref name="foreign-elements"/>
            </rng:choice>
        </rng:zeroOrMore>
    </rng:define>

    <rng:define name="Quakeml">
        <rng:optional>
            <rng:element name="bed:eventParameters">
                <rng:ref name="EventParameters"/>
            </rng:element>
        </rng:optional>
        <rng:ref name="foreign-nodes"/>
    </rng:define>

    <rng:start>
        <rng:element name="quakeml">
            <rng:ref name="Quakeml"/>
        </rng:element>
    </rng:start>

</rng:grammar>
```

B.2.2. Basic Event Description Package (QuakeML-RT-BED-1.2.rng)

```
<?xml version="1.0"?>
<rng:grammar xmlns:rng="http://relaxng.org/ns/structure/1.0" xmlns:bed="http://quakeml.org
    /xmlns/bed-rt/1.2" xmlns="http://quakeml.org/xmlns/bed-rt/1.2" ns="http://quakeml.
    org/xmlns/bed-rt/1.2" datatypeLibrary="http://www.w3.org/2001/XMLSchema-datatypes">
  <rng:define name="eventParameters_anything">
    <rng:zeroOrMore>
      <rng:choice>
        <rng:element>
          <rng:anyName/>
          <rng:ref name="eventParameters_anything"/>
        </rng:element>
        <rng:attribute>
          <rng:anyName/>
        </rng:attribute>
        <rng:text/>
      </rng:choice>
    </rng:zeroOrMore>
  </rng:define>
  <rng:define name="eventParameters_foreign-elements">
    <rng:zeroOrMore>
      <rng:element>
        <rng:anyName>
          <rng:except>
            <rng:nsName ns=""/>
            <rng:nsName ns="http://quakeml.org/xmlns/bed-rt/1.2"/>
          </rng:except>
        </rng:anyName>
        <rng:ref name="eventParameters_anything"/>
      </rng:element>
    </rng:zeroOrMore>
  </rng:define>
  <rng:define name="eventParameters_foreign-attributes">
    <rng:zeroOrMore>
      <rng:attribute>
        <rng:anyName>
          <rng:except>
            <rng:nsName ns=""/>
            <rng:nsName ns="http://quakeml.org/xmlns/bed-rt/1.2"/>
          </rng:except>
        </rng:anyName>
      </rng:attribute>
    </rng:zeroOrMore>
  </rng:define>
```

```
<rng:define name="eventParameters_foreign-nodes">
  <rng:zeroOrMore>
    <rng:choice>
      <rng:ref name="eventParameters_foreign-attributes"/>
      <rng:ref name="eventParameters_foreign-elements"/>
    </rng:choice>
  </rng:zeroOrMore>
</rng:define>
<rng:define name="ResourceIdentifier">
  <rng:data type="anyURI">
    <rng:param name="pattern">(smi|quakeml):[\w\d][\w\d\-\.\*\(\)_~']{2,}/[\w\d
          \-\.\*\(\)_~'][\w\d\-\.\*\(\)\+\?_~'=,;#/&amp;]*</rng:param>
  </rng:data>
</rng:define>
<rng:define name="OriginUncertaintyDescription">
  <rng:choice>
    <rng:value type="string">horizontal uncertainty</rng:value>
    <rng:value type="string">uncertainty ellipse</rng:value>
    <rng:value type="string">confidence ellipsoid</rng:value>
  </rng:choice>
</rng:define>
<rng:define name="AmplitudeCategory">
  <rng:choice>
    <rng:value type="string">point</rng:value>
    <rng:value type="string">mean</rng:value>
    <rng:value type="string">duration</rng:value>
    <rng:value type="string">period</rng:value>
    <rng:value type="string">integral</rng:value>
    <rng:value type="string">other</rng:value>
  </rng:choice>
</rng:define>
<rng:define name="OriginDepthType">
  <rng:choice>
    <rng:value type="string">from location</rng:value>
    <rng:value type="string">from moment tensor inversion</rng:value>
    <rng:value type="string">from modeling of broad-band P waveforms</rng:value>
    <rng:value type="string">constrained by depth phases</rng:value>
    <rng:value type="string">constrained by direct phases</rng:value>
    <rng:value type="string">constrained by depth and direct phases</rng:value>
    <rng:value type="string">operator assigned</rng:value>
    <rng:value type="string">other</rng:value>
  </rng:choice>
</rng:define>
<rng:define name="OriginType">
  <rng:choice>
    <rng:value type="string">hypocenter</rng:value>
    <rng:value type="string">centroid</rng:value>
    <rng:value type="string">amplitude</rng:value>
    <rng:value type="string">macroseismic</rng:value>
    <rng:value type="string">rupture start</rng:value>
    <rng:value type="string">rupture end</rng:value>
  </rng:choice>
</rng:define>
<rng:define name="MTInversionType">
  <rng:choice>
    <rng:value type="string">general</rng:value>
    <rng:value type="string">zero trace</rng:value>
    <rng:value type="string">double couple</rng:value>
  </rng:choice>
</rng:define>
<rng:define name="EvaluationMode">
  <rng:choice>
    <rng:value type="string">manual</rng:value>
    <rng:value type="string">automatic</rng:value>
  </rng:choice>
</rng:define>
<rng:define name="EvaluationStatus">
  <rng:choice>
```

```
      <rng:value type="string">preliminary</rng:value>
      <rng:value type="string">confirmed</rng:value>
      <rng:value type="string">reviewed</rng:value>
      <rng:value type="string">final</rng:value>
      <rng:value type="string">rejected</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="PickOnset">
    <rng:choice>
      <rng:value type="string">emergent</rng:value>
      <rng:value type="string">impulsive</rng:value>
      <rng:value type="string">questionable</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="DataUsedWaveType">
    <rng:choice>
      <rng:value type="string">P waves</rng:value>
      <rng:value type="string">body waves</rng:value>
      <rng:value type="string">surface waves</rng:value>
      <rng:value type="string">mantle waves</rng:value>
      <rng:value type="string">combined</rng:value>
      <rng:value type="string">unknown</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="AmplitudeUnit">
    <rng:choice>
      <rng:value type="string">m</rng:value>
      <rng:value type="string">s</rng:value>
      <rng:value type="string">m/s</rng:value>
      <rng:value type="string">m/(s*s)</rng:value>
      <rng:value type="string">m*s</rng:value>
      <rng:value type="string">dimensionless</rng:value>
      <rng:value type="string">other</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="EventDescriptionType">
    <rng:choice>
      <rng:value type="string">felt report</rng:value>
      <rng:value type="string">Flinn-Engdahl region</rng:value>
      <rng:value type="string">local time</rng:value>
      <rng:value type="string">tectonic summary</rng:value>
      <rng:value type="string">nearest cities</rng:value>
      <rng:value type="string">earthquake name</rng:value>
      <rng:value type="string">region name</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="MomentTensorCategory">
    <rng:choice>
      <rng:value type="string">teleseismic</rng:value>
      <rng:value type="string">regional</rng:value>
    </rng:choice>
  </rng:define>
  <rng:define name="EventType">
    <rng:choice>
      <rng:value type="string">not existing</rng:value>
      <rng:value type="string">not reported</rng:value>
      <rng:value type="string">earthquake</rng:value>
      <rng:value type="string">anthropogenic event</rng:value>
      <rng:value type="string">collapse</rng:value>
      <rng:value type="string">cavity collapse</rng:value>
      <rng:value type="string">mine collapse</rng:value>
      <rng:value type="string">building collapse</rng:value>
      <rng:value type="string">explosion</rng:value>
      <rng:value type="string">accidental explosion</rng:value>
      <rng:value type="string">chemical explosion</rng:value>
      <rng:value type="string">controlled explosion</rng:value>
      <rng:value type="string">experimental explosion</rng:value>
      <rng:value type="string">industrial explosion</rng:value>
```

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```xml
        <rng:value type="string">mining explosion</rng:value>
        <rng:value type="string">quarry blast</rng:value>
        <rng:value type="string">road cut</rng:value>
        <rng:value type="string">blasting levee</rng:value>
        <rng:value type="string">nuclear explosion</rng:value>
        <rng:value type="string">induced or triggered event</rng:value>
        <rng:value type="string">rock burst</rng:value>
        <rng:value type="string">reservoir loading</rng:value>
        <rng:value type="string">fluid injection</rng:value>
        <rng:value type="string">fluid extraction</rng:value>
        <rng:value type="string">crash</rng:value>
        <rng:value type="string">plane crash</rng:value>
        <rng:value type="string">train crash</rng:value>
        <rng:value type="string">boat crash</rng:value>
        <rng:value type="string">other event</rng:value>
        <rng:value type="string">atmospheric event</rng:value>
        <rng:value type="string">sonic boom</rng:value>
        <rng:value type="string">sonic blast</rng:value>
        <rng:value type="string">acoustic noise</rng:value>
        <rng:value type="string">thunder</rng:value>
        <rng:value type="string">avalanche</rng:value>
        <rng:value type="string">snow avalanche</rng:value>
        <rng:value type="string">debris avalanche</rng:value>
        <rng:value type="string">hydroacoustic event</rng:value>
        <rng:value type="string">ice quake</rng:value>
        <rng:value type="string">slide</rng:value>
        <rng:value type="string">landslide</rng:value>
        <rng:value type="string">rockslide</rng:value>
        <rng:value type="string">meteorite</rng:value>
        <rng:value type="string">volcanic eruption</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="EventTypeCertainty">
    <rng:choice>
        <rng:value type="string">known</rng:value>
        <rng:value type="string">suspected</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="SourceTimeFunctionType">
    <rng:choice>
        <rng:value type="string">box car</rng:value>
        <rng:value type="string">triangle</rng:value>
        <rng:value type="string">trapezoid</rng:value>
        <rng:value type="string">unknown</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="PickPolarity">
    <rng:choice>
        <rng:value type="string">positive</rng:value>
        <rng:value type="string">negative</rng:value>
        <rng:value type="string">undecidable</rng:value>
    </rng:choice>
</rng:define>
<rng:define name="TimeQuantity">
    <rng:interleave>
        <rng:element name="value">
            <rng:data type="dateTime"/>
        </rng:element>
        <rng:optional>
            <rng:element name="uncertainty">
                <rng:data type="double"/>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="lowerUncertainty">
                <rng:data type="double"/>
            </rng:element>
        </rng:optional>
```

```
    <rng:optional >
      <rng:element  name="upperUncertainty">
        <rng:data  type="double"/>
      </rng:element >
    </rng:optional >
    <rng:optional >
      <rng:element  name="confidenceLevel">
        <rng:data  type="double"/>
      </rng:element >
    </rng:optional >
  </rng:interleave >
  <rng:ref  name="eventParameters_foreign -elements"/>
  <rng:ref  name="eventParameters_foreign -attributes"/>
</rng:define >
<rng:define  name="ResourceReference">
  <rng:ref  name="ResourceIdentifier"/>
</rng:define >
<rng:define  name="CreationInfo">
  <rng:interleave >
    <rng:optional >
      <rng:element  name="agencyID">
        <rng:data  type="string">
          <rng:param  name="maxLength">64</rng:param >
        </rng:data >
      </rng:element >
    </rng:optional >
    <rng:optional >
      <rng:element  name="agencyURI">
        <rng:ref  name="ResourceReference"/>
      </rng:element >
    </rng:optional >
    <rng:optional >
      <rng:element  name="author">
        <rng:data  type="string">
          <rng:param  name="maxLength">128</rng:param >
        </rng:data >
      </rng:element >
    </rng:optional >
    <rng:optional >
      <rng:element  name="authorURI">
        <rng:ref  name="ResourceReference"/>
      </rng:element >
    </rng:optional >
    <rng:optional >
      <rng:element  name="creationTime">
        <rng:data  type="dateTime"/>
      </rng:element >
    </rng:optional >
    <rng:optional >
      <rng:element  name="version">
        <rng:data  type="string">
          <rng:param  name="maxLength">64</rng:param >
        </rng:data >
      </rng:element >
    </rng:optional >
  </rng:interleave >
  <rng:ref  name="eventParameters_foreign -elements"/>
  <rng:ref  name="eventParameters_foreign -attributes"/>
</rng:define >
<rng:define  name="EventDescription">
  <rng:interleave >
    <rng:element  name="text">
      <rng:data  type="string"/>
    </rng:element >
    <rng:optional >
      <rng:element  name="type">
        <rng:ref  name="EventDescriptionType"/>
      </rng:element >
```

```
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="Phase">
    <rng:data type="string">
      <rng:param name="maxLength">32</rng:param>
    </rng:data>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="Comment">
    <rng:interleave>
      <rng:element name="text">
        <rng:data type="string"/>
      </rng:element>
      <rng:optional>
        <rng:element name="creationInfo">
          <rng:ref name="CreationInfo"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:optional>
      <rng:attribute name="id">
        <rng:ref name="ResourceReference"/>
      </rng:attribute>
    </rng:optional>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="Axis">
    <rng:interleave>
      <rng:element name="azimuth">
        <rng:ref name="RealQuantity"/>
      </rng:element>
      <rng:element name="plunge">
        <rng:ref name="RealQuantity"/>
      </rng:element>
      <rng:element name="length">
        <rng:ref name="RealQuantity"/>
      </rng:element>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="PrincipalAxes">
    <rng:interleave>
      <rng:element name="tAxis">
        <rng:ref name="Axis"/>
      </rng:element>
      <rng:element name="pAxis">
        <rng:ref name="Axis"/>
      </rng:element>
      <rng:optional>
        <rng:element name="nAxis">
          <rng:ref name="Axis"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="DataUsed">
    <rng:interleave>
      <rng:element name="waveType">
        <rng:ref name="DataUsedWaveType"/>
      </rng:element>
      <rng:optional>
```

```
          <rng:element name="stationCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="componentCount">
            <rng:data type="integer"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="shortestPeriod">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="longestPeriod">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
    </rng:define>
    <rng:define name="CompositeTime">
      <rng:interleave>
        <rng:optional>
          <rng:element name="year">
            <rng:ref name="IntegerQuantity"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="month">
            <rng:ref name="IntegerQuantity"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="day">
            <rng:ref name="IntegerQuantity"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="hour">
            <rng:ref name="IntegerQuantity"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="minute">
            <rng:ref name="IntegerQuantity"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="second">
            <rng:ref name="RealQuantity"/>
          </rng:element>
        </rng:optional>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
    </rng:define>
    <rng:define name="Tensor">
      <rng:interleave>
        <rng:element name="Mrr">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mtt">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mpp">
```

```
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mrt">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mrp">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="Mtp">
          <rng:ref name="RealQuantity"/>
        </rng:element>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
</rng:define>
<rng:define name="OriginQuality">
  <rng:interleave>
    <rng:optional>
      <rng:element name="associatedPhaseCount">
        <rng:data type="integer"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="usedPhaseCount">
        <rng:data type="integer"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="associatedStationCount">
        <rng:data type="integer"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="usedStationCount">
        <rng:data type="integer"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="depthPhaseCount">
        <rng:data type="integer"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="standardError">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="azimuthalGap">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="secondaryAzimuthalGap">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="groundTruthLevel">
        <rng:data type="string">
          <rng:param name="maxLength">32</rng:param>
        </rng:data>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="maximumDistance">
        <rng:data type="double"/>
      </rng:element>
```

```xml
        </rng:optional>
        <rng:optional>
          <rng:element name="minimumDistance">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="medianDistance">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
    </rng:define>
    <rng:define name="RealQuantity">
      <rng:interleave>
        <rng:element name="value">
          <rng:data type="double"/>
        </rng:element>
        <rng:optional>
          <rng:element name="uncertainty">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="lowerUncertainty">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="upperUncertainty">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
        <rng:optional>
          <rng:element name="confidenceLevel">
            <rng:data type="double"/>
          </rng:element>
        </rng:optional>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
    </rng:define>
    <rng:define name="NodalPlane">
      <rng:interleave>
        <rng:element name="strike">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="dip">
          <rng:ref name="RealQuantity"/>
        </rng:element>
        <rng:element name="rake">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:interleave>
      <rng:ref name="eventParameters_foreign-elements"/>
      <rng:ref name="eventParameters_foreign-attributes"/>
    </rng:define>
    <rng:define name="TimeWindow">
      <rng:interleave>
        <rng:element name="begin">
          <rng:data type="double"/>
        </rng:element>
        <rng:element name="end">
          <rng:data type="double"/>
        </rng:element>
        <rng:element name="reference">
```

```
        <rng:data type="dateTime"/>
      </rng:element>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="WaveformStreamID">
    <rng:optional>
      <rng:ref name="ResourceReference"/>
    </rng:optional>
    <rng:attribute name="networkCode">
      <rng:data type="string">
        <rng:param name="maxLength">8</rng:param>
      </rng:data>
    </rng:attribute>
    <rng:attribute name="stationCode">
      <rng:data type="string">
        <rng:param name="maxLength">8</rng:param>
      </rng:data>
    </rng:attribute>
    <rng:optional>
      <rng:attribute name="channelCode">
        <rng:data type="string">
          <rng:param name="maxLength">8</rng:param>
        </rng:data>
      </rng:attribute>
    </rng:optional>
    <rng:optional>
      <rng:attribute name="locationCode">
        <rng:data type="string">
          <rng:param name="maxLength">8</rng:param>
        </rng:data>
      </rng:attribute>
    </rng:optional>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="IntegerQuantity">
    <rng:interleave>
      <rng:element name="value">
        <rng:data type="integer"/>
      </rng:element>
      <rng:optional>
        <rng:element name="uncertainty">
          <rng:data type="integer"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="lowerUncertainty">
          <rng:data type="integer"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="upperUncertainty">
          <rng:data type="integer"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="confidenceLevel">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="SourceTimeFunction">
    <rng:interleave>
      <rng:element name="type">
```

```
        <rng:ref name="SourceTimeFunctionType"/>
      </rng:element>
      <rng:element name="duration">
        <rng:data type="double"/>
      </rng:element>
      <rng:optional>
        <rng:element name="riseTime">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="decayTime">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="NodalPlanes">
    <rng:interleave>
      <rng:optional>
        <rng:element name="nodalPlane1">
          <rng:ref name="NodalPlane"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="nodalPlane2">
          <rng:ref name="NodalPlane"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:optional>
      <rng:attribute name="preferredPlane">
        <rng:data type="integer"/>
      </rng:attribute>
    </rng:optional>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="ConfidenceEllipsoid">
    <rng:interleave>
      <rng:element name="semiMajorAxisLength">
        <rng:data type="double"/>
      </rng:element>
      <rng:element name="semiMinorAxisLength">
        <rng:data type="double"/>
      </rng:element>
      <rng:element name="semiIntermediateAxisLength">
        <rng:data type="double"/>
      </rng:element>
      <rng:element name="majorAxisPlunge">
        <rng:data type="double"/>
      </rng:element>
      <rng:element name="majorAxisAzimuth">
        <rng:data type="double"/>
      </rng:element>
      <rng:element name="majorAxisRotation">
        <rng:data type="double"/>
      </rng:element>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="Reading">
    <rng:interleave>
      <rng:zeroOrMore>
        <rng:element name="pickReference">
```

```
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:zeroOrMore>
      <rng:zeroOrMore>
        <rng:element name="amplitudeReference">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:zeroOrMore>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:attribute name="publicID">
      <rng:ref name="ResourceReference"/>
    </rng:attribute>
    <rng:ref name="eventParameters_foreign-attributes"/>
  </rng:define>
  <rng:define name="MomentTensor">
    <rng:interleave>
      <rng:zeroOrMore>
        <rng:element name="dataUsed">
          <rng:ref name="DataUsed"/>
        </rng:element>
      </rng:zeroOrMore>
      <rng:zeroOrMore>
        <rng:element name="comment">
          <rng:ref name="Comment"/>
        </rng:element>
      </rng:zeroOrMore>
      <rng:element name="derivedOriginID">
        <rng:ref name="ResourceReference"/>
      </rng:element>
      <rng:optional>
        <rng:element name="momentMagnitudeID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="scalarMoment">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="tensor">
          <rng:ref name="Tensor"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="variance">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="varianceReduction">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="doubleCouple">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="clvd">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="iso">
          <rng:data type="double"/>
```

```
          </rng:element >
        </rng:optional >
        <rng:optional >
          <rng:element  name="greensFunctionID">
            <rng:ref  name="ResourceReference"/>
          </rng:element >
        </rng:optional >
        <rng:optional >
          <rng:element  name="filterID">
            <rng:ref  name="ResourceReference"/>
          </rng:element >
        </rng:optional >
        <rng:optional >
          <rng:element  name="sourceTimeFunction">
            <rng:ref  name="SourceTimeFunction"/>
          </rng:element >
        </rng:optional >
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            <rng:ref  name="ResourceReference"/>
          </rng:element >
        </rng:optional >
        <rng:optional >
          <rng:element  name="category">
            <rng:ref  name="MomentTensorCategory"/>
          </rng:element >
        </rng:optional >
        <rng:optional >
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            <rng:ref  name="MTInversionType"/>
          </rng:element >
        </rng:optional >
        <rng:optional >
          <rng:element  name="creationInfo">
            <rng:ref  name="CreationInfo"/>
          </rng:element >
        </rng:optional >
      </rng:interleave >
      <rng:ref  name="eventParameters_foreign -elements"/>
      <rng:attribute  name="publicID">
        <rng:ref  name="ResourceReference"/>
      </rng:attribute >
      <rng:ref  name="eventParameters_foreign -attributes"/>
    </rng:define >
    <rng:define  name="FocalMechanism">
      <rng:interleave >
        <rng:zeroOrMore >
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            <rng:ref  name="WaveformStreamID"/>
          </rng:element >
        </rng:zeroOrMore >
        <rng:zeroOrMore >
          <rng:element  name="comment">
            <rng:ref  name="Comment"/>
          </rng:element >
        </rng:zeroOrMore >
        <rng:zeroOrMore >
          <rng:element  name="momentTensor">
            <rng:ref  name="MomentTensor"/>
          </rng:element >
        </rng:zeroOrMore >
        <rng:optional >
          <rng:element  name="triggeringOriginID">
            <rng:ref  name="ResourceReference"/>
          </rng:element >
        </rng:optional >
        <rng:optional >
          <rng:element  name="nodalPlanes">
```

```
        <rng:ref name="NodalPlanes"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="principalAxes">
        <rng:ref name="PrincipalAxes"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="azimuthalGap">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="stationPolarityCount">
        <rng:data type="int"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="misfit">
        <rng:data type="double"/>
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    </rng:optional>
    <rng:optional>
      <rng:element name="stationDistributionRatio">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="methodID">
        <rng:ref name="ResourceReference"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="creationInfo">
        <rng:ref name="CreationInfo"/>
      </rng:element>
    </rng:optional>
  </rng:interleave>
  <rng:ref name="eventParameters_foreign-elements"/>
  <rng:attribute name="publicID">
    <rng:ref name="ResourceReference"/>
  </rng:attribute>
  <rng:ref name="eventParameters_foreign-attributes"/>
</rng:define>
<rng:define name="Amplitude">
  <rng:interleave>
    <rng:zeroOrMore>
      <rng:element name="comment">
        <rng:ref name="Comment"/>
      </rng:element>
    </rng:zeroOrMore>
    <rng:element name="genericAmplitude">
      <rng:ref name="RealQuantity"/>
    </rng:element>
    <rng:optional>
      <rng:element name="type">
        <rng:data type="string">
          <rng:param name="maxLength">32</rng:param>
        </rng:data>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="category">
        <rng:ref name="AmplitudeCategory"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
```

```xml
        <rng:element name="unit">
          <rng:ref name="AmplitudeUnit"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="methodID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="period">
          <rng:ref name="RealQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="snr">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="timeWindow">
          <rng:ref name="TimeWindow"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="pickID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="waveformID">
          <rng:ref name="WaveformStreamID"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="filterID">
          <rng:ref name="ResourceReference"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="scalingTime">
          <rng:ref name="TimeQuantity"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="magnitudeHint">
          <rng:data type="string">
            <rng:param name="maxLength">32</rng:param>
          </rng:data>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="evaluationMode">
          <rng:ref name="EvaluationMode"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="evaluationStatus">
          <rng:ref name="EvaluationStatus"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="creationInfo">
          <rng:ref name="CreationInfo"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
```

```
    <rng:attribute name="publicID">
      <rng:ref name="ResourceReference"/>
    </rng:attribute>
    <rng:ref name="eventParameters_foreign-attributes"/>
</rng:define>
<rng:define name="StationMagnitudeContribution">
    <rng:interleave>
      <rng:element name="stationMagnitudeID">
        <rng:ref name="ResourceReference"/>
      </rng:element>
      <rng:optional>
        <rng:element name="residual">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
      <rng:optional>
        <rng:element name="weight">
          <rng:data type="double"/>
        </rng:element>
      </rng:optional>
    </rng:interleave>
    <rng:ref name="eventParameters_foreign-elements"/>
    <rng:ref name="eventParameters_foreign-attributes"/>
</rng:define>
<rng:define name="Magnitude">
    <rng:interleave>
      <rng:zeroOrMore>
        <rng:element name="comment">
          <rng:ref name="Comment"/>
        </rng:element>
      </rng:zeroOrMore>
      <rng:zeroOrMore>
        <rng:element name="stationMagnitudeContribution">
          <rng:ref name="StationMagnitudeContribution"/>
        </rng:element>
      </rng:zeroOrMore>
      <rng:element name="mag">
        <rng:ref name="RealQuantity"/>
      </rng:element>
      <rng:optional>
        <rng:element name="type">
          <rng:data type="string">
            <rng:param name="maxLength">32</rng:param>
          </rng:data>
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