



# QuakeML—An XML Representation of Seismological Data

## Basic Event Description

### Version 1.2

Recommendation  
14 February 2013

#### **This version:**

1.2: <http://quakeml.org/docs/REC?action=AttachFile&do=get&target=QuakeML-BED-20130214.pdf>

#### **Latest version:**

<http://quakeml.org/docs/latest?action=AttachFile&do=get&target=QuakeML-BED.pdf>

#### **Previous versions:**

1.1: <http://quakeml.org/docs/PR?action=AttachFile&do=get&target=QuakeML-BED-20081216.pdf>

1.0.1: <http://quakeml.org/docs/PR?action=AttachFile&do=get&target=QuakeML-BED-20080225.pdf>

1.0: <http://quakeml.org/docs/PR?action=AttachFile&do=get&target=QuakeML-BED-20071213.pdf>

#### **Editors:**

F. Euchner, D. Schorlemmer

#### **Authors:**

Danijel Schorlemmer<sup>1</sup> ([ds@gfz-potsdam.de](mailto:ds@gfz-potsdam.de))  
Joachim Saul<sup>2</sup> ([saul@gfz-potsdam.de](mailto:saul@gfz-potsdam.de))  
Fabian Euchner<sup>3</sup> ([fabian.euchner@sed.ethz.ch](mailto:fabian.euchner@sed.ethz.ch))  
Jan Becker<sup>4</sup> ([jabe@gempa.de](mailto:jabe@gempa.de))  
Ray Buland<sup>5</sup> ([buland@usgs.gov](mailto:buland@usgs.gov))  
Andres Heinloo<sup>2</sup> ([andres@gfz-potsdam.de](mailto:andres@gfz-potsdam.de))  
Linus Kamb<sup>6</sup> ([linusk@u.washington.edu](mailto:linusk@u.washington.edu))  
Philipp Kästli<sup>3</sup> ([philipp.kaestli@sed.ethz.ch](mailto:philipp.kaestli@sed.ethz.ch))  
Alessandro Spinuso<sup>7</sup> ([spinuso@knmi.nl](mailto:spinuso@knmi.nl))  
Bernd Weber<sup>4</sup> ([weber@gempa.de](mailto:weber@gempa.de))

<sup>1</sup> GeoForschungsZentrum Potsdam, Helmholtzstraße 7, 14467 Potsdam, Germany

<sup>2</sup> GeoForschungsZentrum Potsdam, Telegrafenberg, 14437 Potsdam, Germany

<sup>3</sup> Swiss Seismological Service, ETH Zurich, Sonneggstrasse 5, 8092 Zurich, Switzerland

<sup>4</sup> Gempa GmbH, Telegrafenberg, 14437 Potsdam, Germany

<sup>5</sup> National Earthquake Information Center, U.S. Geological Survey, Denver, CO 80225, USA

<sup>6</sup> Joint Institute for the Study of the Atmosphere and Ocean, Univ. of Washington, Seattle, WA 98105, USA

<sup>7</sup> Seismology Division, KNMI, ORFEUS, P.O. Box 201, 3730 AE De Bilt, The Netherlands

<http://www.quakeml.org>  
[quakeml@sed.ethz.ch](mailto:quakeml@sed.ethz.ch)

## 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](http://www.fdsn.org)) in June 2011.

## Acknowledgements

We thank Rémy Bossu, John Clinton, John Douglas, Torild van Eck, Göran Ekström, Paul Friberg, Stéphanie Godey, Paul Grimwood, Winfried Hanka, Maria Liukis, Anthony Lomax, Philip Maechling, Silvio Maraini, Gilles Mazet-Roux, Johannes Schweitzer, Dmitry Storchak, Stefan Wiemer, Jochen Wössner, and Adrian Wyss for their contributions to QuakeML. QuakeML development at ETH Zurich has been funded as part of the NERIES project (EC contract no. 026130). GFZ Potsdam acknowledges funding by the *Bundesministerium für Bildung und Forschung* (GITEWS project).

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# 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)<sup>1</sup>. 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<sup>2</sup> 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<sup>3</sup>.

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<sup>4</sup>.

The contact e-mail address for QuakeML is [quakeml@sed.ethz.ch](mailto:quakeml@sed.ethz.ch).

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<sup>1</sup>Note, however, that the XML format definition given therein is outdated and is superseded by this document.

<sup>2</sup><http://folkworm.ceri.memphis.edu/ew-doc/>

<sup>3</sup><http://www.ivoa.net>

<sup>4</sup>[http://www.quakeml.org/RFC\\_BED\\_1.0](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<sup>5</sup> formulation which serves as a basis for further representations, like XML Schema<sup>6</sup> (XSD), Relax NG<sup>7</sup> (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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<sup>5</sup>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>).

<sup>6</sup><http://www.w3.org/TR/xmlschema-1/>, <http://www.w3.org/TR/xmlschema-2/>

<sup>7</sup><http://www.relaxng.org>

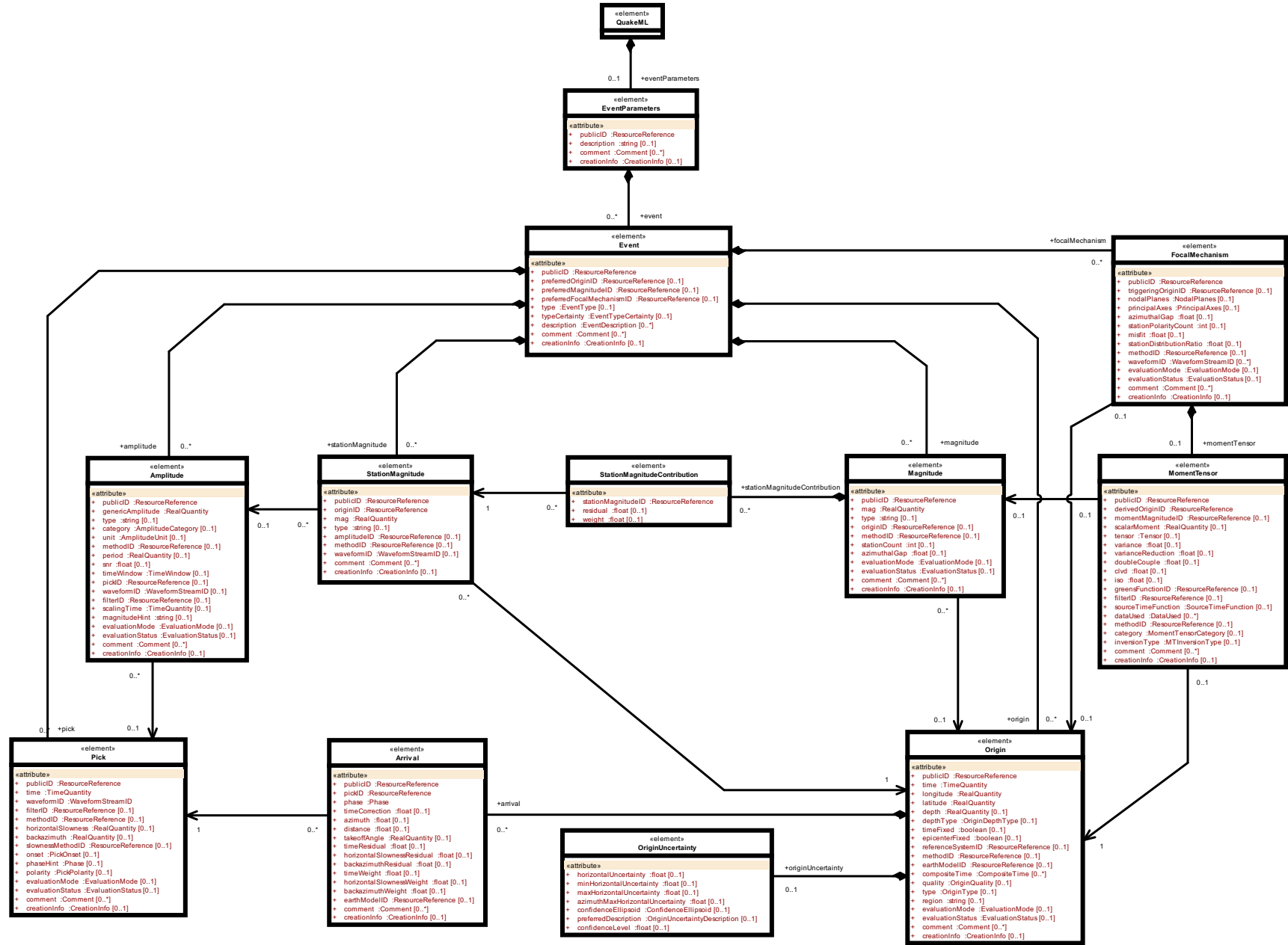


Figure 1: UML class diagram of the QuakeML BED data model. Two different types of relations between classes are used: (i) compositions, marked by lines with filled diamonds; and (ii) associations, marked by arrows. Compositions indicate a stronger coupling between two classes than associations.

**Figure 2:** UML class diagram of the QuakeML BED-RT (real-time processing) data model.





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<sup>8</sup> 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

$$[smi|quakeml]:\langle\text{authority-id}\rangle/\langle\text{resource-id}\rangle[\#\langle\text{local-id}\rangle]$$

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.

<sup>8</sup>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 *ResourceIdentifier* 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<sup>9</sup> (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<sup>10</sup>. 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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<sup>9</sup><http://www.bipm.org/en/si/>

<sup>10</sup>[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=40874](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
<b>resourceID</b>	<i>string</i>	1	<i>RI</i>	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
<b>value</b>	<i>int/float</i>	1	<i>xs:integer/xs:double</i>	Element
<b>uncertainty</b>	<i>int/float</i>	0..1	<i>xs:integer/xs:double</i>	Element
<b>lowerUncertainty</b>	<i>int/float</i>	0..1	<i>xs:integer/xs:double</i>	Element
<b>upperUncertainty</b>	<i>int/float</i>	0..1	<i>xs:integer/xs:double</i>	Element
<b>confidenceLevel</b>	<i>float</i>	0..1	<i>xs:double</i>	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.

#### XML example

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  $1\sigma$  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.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>value</b>	<i>datetime</i>	1	<i>xs:dateTime</i>	Element
<b>uncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>lowerUncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>upperUncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>confidenceLevel</b>	<i>float</i>	0..1	<i>xs:double</i>	Element

#### Description of Attributes

**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.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>begin</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>end</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>reference</b>	<i>datetime</i>	1	<i>xs:dateTime</i>	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
<b>networkCode</b>	<i>string</i>	1	<i>xs:string</i>	Attribute
<b>stationCode</b>	<i>string</i>	1	<i>xs:string</i>	Attribute
<b>channelCode</b>	<i>string</i>	0..1	<i>xs:string</i>	Attribute
<b>locationCode</b>	<i>string</i>	0..1	<i>xs:string</i>	Attribute
<b>resourceURI</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	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
<b>code</b>	<i>string</i>	1	<i>xs:string</i>	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
<b>year</b>	<i>IntegerQuantity</i>	0..1	—	—
<b>month</b>	<i>IntegerQuantity</i>	0..1	—	—
<b>day</b>	<i>IntegerQuantity</i>	0..1	—	—
<b>hour</b>	<i>IntegerQuantity</i>	0..1	—	—
<b>minute</b>	<i>IntegerQuantity</i>	0..1	—	—
<b>second</b>	<i>RealQuantity</i>	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
<b>associatedPhaseCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>usedPhaseCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>associatedStationCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>usedStationCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>depthPhaseCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>standardError</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>azimuthalGap</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>secondaryAzimuthalGap</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>groundTruthLevel</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>minimumDistance</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>maximumDistance</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>medianDistance</b>	<i>float</i>	0..1	<i>xs:double</i>	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

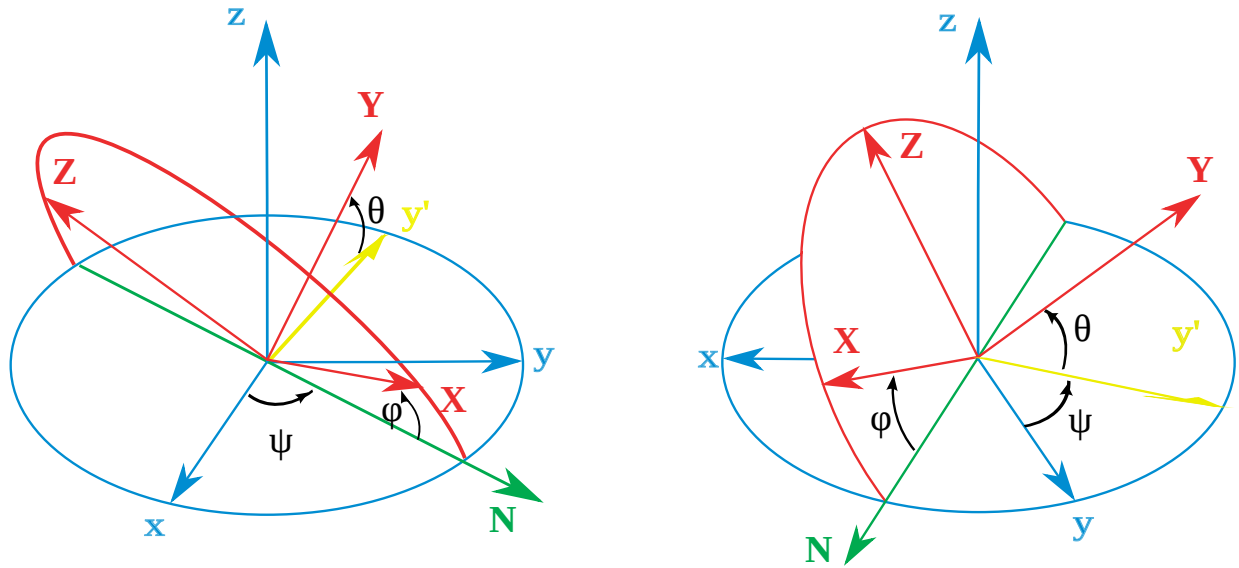
**maximumDistance** Epicentral distance of station farthest from the epicenter.

*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](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,  $\psi$ ), elevation (attitude, pitch,  $\varphi$ ), and bank (roll,  $\theta$ ). 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  $\psi$  (heading, or azimuth); (ii) a rotation about the  $Y$  axis with angle  $\varphi$  (elevation, or plunge); and (iii) a rotation about the  $X$  axis with angle  $\theta$  (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)
<b>majorAxisPlunge</b>	elevation (pitch)	$\varphi$
<b>majorAxisAzimuth</b>	heading (yaw)	$\psi$
<b>majorAxisRotation</b>	bank (roll)	$\theta$

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>semiMajorAxisLength</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>semiMinorAxisLength</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>semiIntermediateAxisLength</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>majorAxisPlunge</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>majorAxisAzimuth</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>majorAxisRotation</b>	<i>float</i>	1	<i>xs:double</i>	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  $\varphi$ .

*Unit: deg*

**majorAxisAzimuth** Azimuth angle of major axis of confidence ellipsoid. Corresponds to Tait-Bryan angle  $\psi$ .

*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  $\theta$ .

*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
<b>nodalPlane1</b>	<i>NodalPlane</i>	0..1	–	–
<b>nodalPlane2</b>	<i>NodalPlane</i>	0..1	–	–
<b>preferredPlane</b>	<i>int</i>	0..1	<i>xs:integer</i>	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.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>tAxis</b>	<i>Axis</i>	1	–	–
<b>pAxis</b>	<i>Axis</i>	1	–	–
<b>nAxis</b>	<i>Axis</i>	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
<b>strike</b>	<i>RealQuantity</i>	1	–	–
<b>dip</b>	<i>RealQuantity</i>	1	–	–
<b>rake</b>	<i>RealQuantity</i>	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**.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>azimuth</b>	<i>RealQuantity</i>	1	–	–
<b>plunge</b>	<i>RealQuantity</i>	1	–	–
<b>length</b>	<i>RealQuantity</i>	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
<b>Mrr</b>	<i>RealQuantity</i>	1	–	–
<b>Mtt</b>	<i>RealQuantity</i>	1	–	–
<b>Mpp</b>	<i>RealQuantity</i>	1	–	–
<b>Mrt</b>	<i>RealQuantity</i>	1	–	–
<b>Mrp</b>	<i>RealQuantity</i>	1	–	–
<b>Mtp</b>	<i>RealQuantity</i>	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

#### XML example

See Sect. 3.5.7.

### 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
<b>waveType</b>	<i>enum (DataUsedWaveType)</i>	1	–	Element
<b>stationCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>componentCount</b>	<i>int</i>	0..1	<i>xs:integer</i>	Element
<b>shortestPeriod</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>longestPeriod</b>	<i>float</i>	0..1	<i>xs:double</i>	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.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>type</b>	<i>enum (SourceTimeFunctionType)</i>	1	–	Element
<b>duration</b>	<i>float</i>	1	<i>xs:double</i>	Element
<b>riseTime</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>decayTime</b>	<i>float</i>	0..1	<i>xs:double</i>	Element

#### Description of Attributes

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

<b>SourceTimeFunction (enum)</b>
<ul style="list-style-type: none"><li>• box car</li><li>• triangle</li><li>• trapezoid</li><li>• unknown</li></ul>

**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**.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>text</b>	<i>string</i>	1	<i>xs:string</i>	Element
<b>type</b>	<i>enum (EventDescriptionType)</i>	0..1	–	Element

#### Description of Attributes

**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
<b>agencyID</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>agencyURI</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>author</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>authorURI</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>creationTime</b>	<i>datetime</i>	0..1	<i>xs:dateTime</i>	Element
<b>version</b>	<i>string</i>	0..1	<i>xs:string</i>	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
<b>text</b>	<i>string</i>	1	<i>xs:string</i>	Element
<b>id</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Attribute
<b>creationInfo</b>	<i>CreationInfo</i>	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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>description</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	0..1	–	–

#### List of child elements

Attribute	UML Type	Multiplicity
<b>event</b>	<i>Event</i>	0..*
<i>only in real-time variant:</i>		
<b>origin</b>	<i>Origin</i>	0..*
<b>magnitude</b>	<i>Magnitude</i>	0..*
<b>stationMagnitude</b>	<i>StationMagnitude</i>	0..*
<b>focalMechanism</b>	<i>FocalMechanism</i>	0..*
<b>reading</b>	<i>Reading</i>	0..*
<b>pick</b>	<i>Pick</i>	0..*
<b>amplitude</b>	<i>Amplitude</i>	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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>preferredOriginID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>preferredMagnitudeID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>preferredFocalMechanismID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>type</b>	<i>enum (EventType)</i>	0..1	–	Element
<b>typeCertainty</b>	<i>enum (EventTypeCertainty)</i>	0..1	–	Element
<b>description</b>	<i>EventDescription</i>	0..*	–	–
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	0..1	–	–
<i>only in real-time variant:</i>				
<b>originReference</b>	<i>ResourceReference</i>	0..*	<i>RI</i>	Element
<b>magnitudeReference</b>	<i>ResourceReference</i>	0..*	<i>RI</i>	Element
<b>focalMechanismReference</b>	<i>ResourceReference</i>	0..*	<i>RI</i>	Element

#### List of child elements

Attribute	UML Type	Multiplicity
<i>only in bulletin (non-RT) variant:</i>		
<b>origin</b>	<i>Origin</i>	0..*
<b>magnitude</b>	<i>Magnitude</i>	0..*
<b>stationMagnitude</b>	<i>StationMagnitude</i>	0..*
<b>focalMechanism</b>	<i>FocalMechanism</i>	0..*
<b>pick</b>	<i>Pick</i>	0..*
<b>amplitude</b>	<i>Amplitude</i>	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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>time</b>	<i>TimeQuantity</i>	1	–	–
<b>longitude</b>	<i>RealQuantity</i>	1	–	–
<b>latitude</b>	<i>RealQuantity</i>	1	–	–
<b>depth</b>	<i>RealQuantity</i>	0..1	–	–
<b>depthType</b>	<i>enum (OriginDepthType)</i>	0..1	–	Element
<b>timeFixed</b>	<i>boolean</i>	0..1	<i>xs:boolean</i>	Element
<b>epicenterFixed</b>	<i>boolean</i>	0..1	<i>xs:boolean</i>	Element
<b>referenceSystemID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>methodID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>earthModelID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>compositeTime</b>	<i>CompositeTime</i>	0..*	–	–
<b>quality</b>	<i>OriginQuality</i>	0..1	–	–
<b>type</b>	<i>enum (OriginType)</i>	0..1	–	Element
<b>region</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>evaluationMode</b>	<i>enum (EvaluationMode)</i>	0..1	–	Element
<b>evaluationStatus</b>	<i>enum (EvaluationStatus)</i>	0..1	–	Element
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	0..1	–	–

#### List of child elements

Attribute	UML Type	Multiplicity
<b>arrival</b>	<i>Arrival</i>	0..*
<b>originUncertainty</b>	<i>OriginUncertainty</i>	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 describe 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
<b>horizontalUncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>minHorizontalUncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>maxHorizontalUncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>azimuthMaxHorizontalUncertainty</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>confidenceEllipsoid</b>	<i>ConfidenceEllipsoid</i>	0..1	–	–
<b>preferredDescription</b>	<i>enum</i> ( <i>OriginUncertaintyDescription</i> )	0..1	–	Element
<b>confidenceLevel</b>	<i>float</i>	0..1	<i>xs:double</i>	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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute

List of child elements

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

#### List of child elements

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

## XML example

```
<momentTensor>
  <derivedOriginID>smi:org.globalcmt/origin/C20050101010120A</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.

#### List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>originID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Element
<b>mag</b>	<i>RealQuantity</i>	1	–	–
<b>type</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>amplitudeID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>methodID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>waveformID</b>	<i>WaveformStreamID</i>	0..1	–	–
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	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
<b>stationMagnitudeID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Element
<b>residual</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>weight</b>	<i>float</i>	0..1	<i>xs:double</i>	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.

## List of Attributes

Attribute	UML Type	Multiplicity	XML Type	XML Representation
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>pickID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Element
<b>phase</b>	<i>Phase</i>	1	–	–
<b>timeCorrection</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>azimuth</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>distance</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>takeoffAngle</b>	<i>RealQuantity</i>	0..1	–	–
<b>timeResidual</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>horizontalSlownessResidual</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>backazimuthResidual</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>timeWeight</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>horizontalSlownessWeight</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>backazimuthWeight</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>earthModelID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	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:* s · deg<sup>-1</sup>

**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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>time</b>	<i>TimeQuantity</i>	1	–	–
<b>waveformID</b>	<i>WaveformStreamID</i>	1	–	–
<b>filterID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>methodID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>horizontalSlowness</b>	<i>RealQuantity</i>	0..1	–	–
<b>backazimuth</b>	<i>RealQuantity</i>	0..1	–	–
<b>slownessMethodID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>onset</b>	<i>enum (PickOnset)</i>	0..1	–	Element
<b>phaseHint</b>	<i>Phase</i>	0..1	–	–
<b>polarity</b>	<i>enum (PickPolarity)</i>	0..1	–	Element
<b>evaluationMode</b>	<i>enum (EvaluationMode)</i>	0..1	–	Element
<b>evaluationStatus</b>	<i>enum (EvaluationStatus)</i>	0..1	–	Element
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	0..1	–	–

#### Description of Attributes

**publicID** Resource identifier of *Pick*.

**time** Observed onset time of signal (“pick time”).

**waveformID** Identifies 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 · deg<sup>-1</sup>

**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>
  </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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>genericAmplitude</b>	<i>RealQuantity</i>	1	–	–
<b>type</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>category</b>	<i>enum (AmplitudeCategory)</i>	0..1	–	Element
<b>unit</b>	<i>enum (AmplitudeUnit)</i>	0..1	–	Element
<b>methodID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>period</b>	<i>RealQuantity</i>	0..1	–	–
<b>snr</b>	<i>float</i>	0..1	<i>xs:double</i>	Element
<b>timeWindow</b>	<i>TimeWindow</i>	0..1	–	–
<b>pickID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>waveformID</b>	<i>WaveformStreamID</i>	0..1	–	–
<b>filterID</b>	<i>ResourceReference</i>	0..1	<i>RI</i>	Element
<b>scalingTime</b>	<i>TimeQuantity</i>	0..1	–	–
<b>magnitudeHint</b>	<i>string</i>	0..1	<i>xs:string</i>	Element
<b>evaluationMode</b>	<i>enum (EvaluationMode)</i>	0..1	–	Element
<b>evaluationStatus</b>	<i>enum (EvaluationStatus)</i>	0..1	–	Element
<b>comment</b>	<i>Comment</i>	0..*	–	–
<b>creationInfo</b>	<i>CreationInfo</i>	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 be 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.

#### XML example

```
<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
<b>publicID</b>	<i>ResourceReference</i>	1	<i>RI</i>	Attribute
<b>pickReference</b>	<i>ResourceReference</i>	0..*	<i>RI</i>	Element
<b>amplitudeReference</b>	<i>ResourceReference</i>	0..*	<i>RI</i>	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/amplitude/367523</amplitudeReference>
</reading>
```

## 4. References

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## 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<sup>11</sup>.

### 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>
  </xs:simpleType>
```

<sup>11</sup>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:restriction>
</xs:simpleType>

```

```

<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"/>
  </xs:restriction>
</xs:simpleType>

```

```

        <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:choice>
    </xs:sequence>
</xs:complexType>

```

```

    </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:choice>
        <xs:element name="groundTruthLevel" minOccurs="0" maxOccurs="1">
            <xs:simpleType>
                <xs:restriction base="xs:string">

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```

        <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:extension>
    </xs:simpleContent>

```

```

        <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:choice>
    </xs:sequence>
  </xs:complexType>

```



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        <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="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:choice>
    </xs:sequence>
    <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

```

```

<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="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="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>

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```

<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>

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        <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"/>
            <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: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="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:choice>
    </xs:sequence>
    <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
    <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

```

```

<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"/>
<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="Pick">
    <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="description" type="bed:EventDescription"/>
      <xs:element name="comment" type="bed:Comment"/>
      <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="
        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="EventParameters">
  <xs:sequence>
    <xs:choice minOccurs="0" maxOccurs="unbounded">
      <xs:element name="comment" type="bed:Comment"/>
      <xs:element name="event" type="bed:Event"/>
      <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>

```

## 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: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:sequence>

```

```

        <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:choice>
    </xs:sequence>

```

```

        <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:extension>
  </xs:simpleContent>

```

```

        </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:choice>
  </xs:sequence>
  <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

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```

<xs:element name="methodID" minOccurs="0" maxOccurs="1" type="
    bed:ResourceReference"/>
<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="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">

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        <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>

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</xs:sequence>
<xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
<xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>
<xs:complexType name="Pick">
  <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:choice>
  </xs:sequence>
  <xs:attribute name="publicID" use="required" type="bed:ResourceReference"/>
  <xs:anyAttribute namespace="##other" processContents="lax"/>
</xs:complexType>

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        <xs:element name="minHorizontalUncertainty" minOccurs="0" maxOccurs="1" type="
            xs:double"/>
        <xs:element name="maxHorizontalUncertainty" minOccurs="0" maxOccurs="1" type="
            xs:double"/>
        <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: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="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:choice>
    </xs:sequence>

```

```

<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"/>
<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<sup>12</sup>.

### 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>
```

---

<sup>12</sup>BED: <http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-1.2.rng>,  
BED-RT: <http://quakeml.org/docs/xml?action=AttachFile&do=get&target=QuakeML-BED-1.2.rng>,  
<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>
<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">(smil|quakeml):[\w\d][\w\d\-\.\*\(\)\_~']{2,}/[\w\d\-\.\*\(\)\_~'][\w\d\-\.\*\(\)\_~']*</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="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:choice>
</rng:define>

```



```

        <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: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:define>

```

```

    </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:define>

```

```

    </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:interleave>
</rng:define>

```

```

        </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: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:interleave>
  </rng:define>

```

```

    </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="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:interleave>

```

```

</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>
<rng:optional>
  <rng:element name="methodID">
    <rng:ref name="ResourceReference"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="category">
    <rng:ref name="MomentTensorCategory"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="inversionType">
    <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>
      <rng:element name="waveformID">
        <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:interleave>
</rng:define>

```

```

        </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"/>
        </rng:element>
    </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="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="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>
    <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: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>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="originID">
                <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="stationCount">
                <rng:data type="integer"/>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="azimuthalGap">
                <rng:data type="double"/>
            </rng:element>
        </rng:optional>
    </rng:interleave>

```

```

        </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="StationMagnitude">
    <rng:interleave>
        <rng:zeroOrMore>
            <rng:element name="comment">
                <rng:ref name="Comment"/>
            </rng:element>
        </rng:zeroOrMore>
        <rng:element name="originID">
            <rng:ref name="ResourceReference"/>
        </rng:element>
        <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>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="amplitudeID">
                <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="waveformID">
                <rng:ref name="WaveformStreamID"/>
            </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:attribute>
    <rng:ref name="eventParameters_foreign-attributes"/>
</rng:define>
<rng:define name="OriginUncertainty">
  <rng:interleave>
    <rng:optional>
      <rng:element name="horizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="minHorizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="maxHorizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="azimuthMaxHorizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="confidenceEllipsoid">
        <rng:ref name="ConfidenceEllipsoid"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="preferredDescription">
        <rng:ref name="OriginUncertaintyDescription"/>
      </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="Arrival">
  <rng:interleave>
    <rng:zeroOrMore>
      <rng:element name="comment">
        <rng:ref name="Comment"/>
      </rng:element>
    </rng:zeroOrMore>
    <rng:element name="pickID">
      <rng:ref name="ResourceReference"/>
    </rng:element>
    <rng:element name="phase">
      <rng:ref name="Phase"/>
    </rng:element>
    <rng:optional>
      <rng:element name="timeCorrection">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="azimuth">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
  </rng:interleave>
</rng:define>

```

```

        <rng:element name="distance">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="takeoffAngle">
            <rng:ref name="RealQuantity"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="timeResidual">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="horizontalSlownessResidual">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="backazimuthResidual">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="timeWeight">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="horizontalSlownessWeight">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="backazimuthWeight">
            <rng:data type="double"/>
        </rng:element>
    </rng:optional>
    <rng:optional>
        <rng:element name="earthModelID">
            <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="Origin">
    <rng:interleave>
        <rng:zeroOrMore>
            <rng:element name="compositeTime">
                <rng:ref name="CompositeTime"/>
            </rng:element>
        </rng:zeroOrMore>
        <rng:zeroOrMore>
            <rng:element name="comment">
                <rng:ref name="Comment"/>
            </rng:element>
        </rng:zeroOrMore>
    </rng:interleave>

```



```

<rng:zeroOrMore>
  <rng:element name="originUncertainty">
    <rng:ref name="OriginUncertainty"/>
  </rng:element>
</rng:zeroOrMore>
<rng:zeroOrMore>
  <rng:element name="arrival">
    <rng:ref name="Arrival"/>
  </rng:element>
</rng:zeroOrMore>
<rng:element name="time">
  <rng:ref name="TimeQuantity"/>
</rng:element>
<rng:element name="longitude">
  <rng:ref name="RealQuantity"/>
</rng:element>
<rng:element name="latitude">
  <rng:ref name="RealQuantity"/>
</rng:element>
<rng:optional>
  <rng:element name="depth">
    <rng:ref name="RealQuantity"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="depthType">
    <rng:ref name="OriginDepthType"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="timeFixed">
    <rng:data type="boolean"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="epicenterFixed">
    <rng:data type="boolean"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="referenceSystemID">
    <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="earthModelID">
    <rng:ref name="ResourceReference"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="quality">
    <rng:ref name="OriginQuality"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="type">
    <rng:ref name="OriginType"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="region">
    <rng:data type="string">
      <rng:param name="maxLength">128</rng:param>
    </rng:element>
  </rng:optional>

```

```

        </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="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:interleave>
</rng:define>

```

```

<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:element>
  </rng:interleave>

```

```

</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 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\-\.\*\(\)\_~']*</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>

```



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    <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>
  </rng:choice>

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    <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:interleave>
</rng:define>

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```

    <rng:optional>
      <rng:element name="upperUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
  </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:define>

```

```

        </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>
        </rng:optional>
    </rng:interleave>

```

```

</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:interleave>
</rng:define>

```

```

    </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>
<rng:optional>
  <rng:element name="methodID">
    <rng:ref name="ResourceReference"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="category">
    <rng:ref name="MomentTensorCategory"/>
  </rng:element>
</rng:optional>
<rng:optional>
  <rng:element name="inversionType">
    <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>
      <rng:element name="waveformID">
        <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"/>
    </rng:element>
</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="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="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>
    <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>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="originID">
                <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="stationCount">

```

```

        <rng:data type="integer"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="azimuthalGap">
        <rng:data type="double"/>
    </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="StationMagnitude">
    <rng:interleave>
        <rng:zeroOrMore>
            <rng:element name="comment">
                <rng:ref name="Comment"/>
            </rng:element>
        </rng:zeroOrMore>
        <rng:element name="originID">
            <rng:ref name="ResourceReference"/>
        </rng:element>
        <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>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="amplitudeID">
                <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="waveformID">
                <rng:ref name="WaveformStreamID"/>
            </rng:element>
        </rng:optional>
        <rng:optional>
            <rng:element name="creationInfo">
                <rng:ref name="CreationInfo"/>
            </rng:element>
        </rng:optional>
    </rng:interleave>
</rng:define>

```

```

        </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:interleave>

```



```

        <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="originReference">
                <rng:ref name="ResourceReference"/>
            </rng:element>
        </rng:zeroOrMore>
        <rng:zeroOrMore>
            <rng:element name="magnitudeReference">
                <rng:ref name="ResourceReference"/>
            </rng:element>
        </rng:zeroOrMore>
        <rng:zeroOrMore>
            <rng:element name="focalMechanismReference">
                <rng:ref name="ResourceReference"/>
            </rng:element>
        </rng:zeroOrMore>
        <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: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:interleave>

```

```

    <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="OriginUncertainty">
  <rng:interleave>
    <rng:optional>
      <rng:element name="horizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="minHorizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="maxHorizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="azimuthMaxHorizontalUncertainty">
        <rng:data type="double"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="confidenceEllipsoid">
        <rng:ref name="ConfidenceEllipsoid"/>
      </rng:element>
    </rng:optional>
    <rng:optional>
      <rng:element name="preferredDescription">
        <rng:ref name="OriginUncertaintyDescription"/>
      </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="Arrival">
  <rng:interleave>
    <rng:zeroOrMore>
      <rng:element name="comment">
        <rng:ref name="Comment"/>
      </rng:element>
    </rng:zeroOrMore>
    <rng:element name="pickID">
      <rng:ref name="ResourceReference"/>
    </rng:element>
    <rng:element name="phase">
      <rng:ref name="Phase"/>
    </rng:element>
    <rng:optional>
      <rng:element name="timeCorrection">

```

```

        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="azimuth">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="distance">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="takeoffAngle">
        <rng:ref name="RealQuantity"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="timeResidual">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="horizontalSlownessResidual">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="backazimuthResidual">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="timeWeight">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="horizontalSlownessWeight">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="backazimuthWeight">
        <rng:data type="double"/>
    </rng:element>
</rng:optional>
<rng:optional>
    <rng:element name="earthModelID">
        <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="Origin">
    <rng:interleave>
        <rng:zeroOrMore>

```

```

    <rng:element name="compositeTime">
      <rng:ref name="CompositeTime"/>
    </rng:element>
  </rng:zeroOrMore>
  <rng:zeroOrMore>
    <rng:element name="comment">
      <rng:ref name="Comment"/>
    </rng:element>
  </rng:zeroOrMore>
  <rng:zeroOrMore>
    <rng:element name="originUncertainty">
      <rng:ref name="OriginUncertainty"/>
    </rng:element>
  </rng:zeroOrMore>
  <rng:zeroOrMore>
    <rng:element name="arrival">
      <rng:ref name="Arrival"/>
    </rng:element>
  </rng:zeroOrMore>
  <rng:element name="time">
    <rng:ref name="TimeQuantity"/>
  </rng:element>
  <rng:element name="longitude">
    <rng:ref name="RealQuantity"/>
  </rng:element>
  <rng:element name="latitude">
    <rng:ref name="RealQuantity"/>
  </rng:element>
  <rng:optional>
    <rng:element name="depth">
      <rng:ref name="RealQuantity"/>
    </rng:element>
  </rng:optional>
  <rng:optional>
    <rng:element name="depthType">
      <rng:ref name="OriginDepthType"/>
    </rng:element>
  </rng:optional>
  <rng:optional>
    <rng:element name="timeFixed">
      <rng:data type="boolean"/>
    </rng:element>
  </rng:optional>
  <rng:optional>
    <rng:element name="epicenterFixed">
      <rng:data type="boolean"/>
    </rng:element>
  </rng:optional>
  <rng:optional>
    <rng:element name="referenceSystemID">
      <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="earthModelID">
      <rng:ref name="ResourceReference"/>
    </rng:element>
  </rng:optional>
  <rng:optional>
    <rng:element name="quality">
      <rng:ref name="OriginQuality"/>
    </rng:element>
  </rng:optional>

```

```

<rng:optional>
  <rng:element name="type">
    <rng:ref name="OriginType"/>
  </rng:element>
</rng:optional>
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</rng:optional>
</rng:interleave>
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<rng:attribute name="publicID">
  <rng:ref name="ResourceReference"/>
</rng:attribute>
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  <rng:interleave>
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    <rng:zeroOrMore>
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</rng:zeroOrMore>
<rng:zeroOrMore>
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<rng:zeroOrMore>
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</rng:optional>
</rng:interleave>
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<rng:attribute name="publicID">
    <rng:ref name="ResourceReference"/>
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</rng:grammar>

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