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National Nuclear Security Administration Knowledge Base Core Table Schema Document

Dorthe Carr

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

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Dorthe Carr
Data Exploitation Department
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185-1138

Abstract

The National Nuclear Security Administration is creating a Knowledge Base to store technical information to support the United States nuclear explosion monitoring mission. This document defines the core database tables that are used in the Knowledge Base.

Acknowledgements

Much of this document was based on work done by SAIC, who have made revisions to the CSS 3.0 schema developed in 1990. Those people include Bonnie MacRitchie, Don Irons, Tammy Lyons, Craig Morency, Brian Pope, Henry Swanger and N. Putvinskaya.

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Tables

1.0 Introduction

The purpose of this document is to present the ORACLE database tables in the NNSA Knowledge Base that are modifications to the CSS3.0 Database Schema developed in 1990. (Anderson et al., 1990). These modifications include additional columns to the affiliation table, an increase in the internal ORACLE format from 8 integers to 9 integers for thirteen IDs, and new primary and unique key definitions for six tables. It is intended to be used as a reference by researchers inside and outside of NNSA/DOE as they compile information to submit to the NNSA Knowledge Base. These “core” tables are separated into two groups. The Primary tables are dynamic and consist of information that can be used in automatic and interactive processing (e.g. arrivals, locations). The Lookup tables change infrequently and are used for auxiliary information used by the processing. In general, the information stored in the core tables consists of:

- arrivals
- events, origins, associations of arrivals
- magnitude information
- station information (networks, site descriptions, instrument responses)
- pointers to waveform data
- comments pertaining to the information

This document is divided into four sections, the first being this introduction. Section two defines the sixteen tables that make up the core tables of the NNSA Knowledge Base database. Both internal (ORACLE) and external formats for the attributes are defined, along with a short description of each attribute. In addition, the primary, unique and foreign keys are defined. Section three of the document shows the relationships between the different tables by using entity-relationship diagrams. The last section, defines the columns or attributes of the various tables. Information that is included is the Not Applicable (NA) value, the format of the data and the applicable range for the attribute.

2.0 Table Descriptions

This section describes the logical structure of each table in the NNSA Core Table Database Schema as it exists within the ORACLE data dictionary and as it can exist as a flat file. The name of the table is first, followed by a description of the purpose and use of the table. Below the description is a listing of the columns, in the order which they are defined in the tables. The storage column gives the actual ORACLE datatype for the column in question. The external format and character positions columns are provided for the convenience of database users who wish to transfer data between the ORACLE database tables and flat files.

2.1 Keys and Data Categories

The columns of the database table are categorized as keys and data. Key columns link database tables. Data columns, the reason that database tables exist, are split into three categories: Descriptive, Measurement, and Administrative. The following explains the format used in the entries:

Keys:	Primary	The columns which, when taken together, uniquely identify a row in the database table.
	Unique	Other columns that also uniquely identify a row and may be used as surrogates for primary keys.
	Foreign	Primary keys in another database table.
Data:	Descriptive	Qualitative columns
	Measurement	Quantitative columns
	Administration	Columns used for database administration

Keys provide the links by which database tables are joined. The following definitions explain the types of keys:

- Primary key: Uniquely identifies a row in a database table (often the concatenation of several columns). For example, every **origin** record is unique by *lat*, *lon*, *depth*, and *time*
- Unique key: Also uniquely identifies a row in a database table and may be used as a surrogate for the primary key. For example, *orid* may also be used as the primary key in the **origin** database table.
- Foreign key: The column or combination of columns in a table used to join to a primary key in another table. For example, *evid* is a foreign key in the **origin** database table but is the primary key in the **event** database table; *commid* is a foreign key in many of the database tables but is the primary key in the **remark** database table.

2.2 Conventions

The following conventions are used:

Conventions

Element	Appearance	Example
Database table	Bold	**arrival**
Database columns	Italic	*sta*
Database table and column when written in the dot notation	Bold.italic	**arrival**.*sta*
Value of a key or component of a key	Courier font	`arid`

2.3 Table Definitions

Tables 2.1 through 2.16 provide table definitions. Each table lists the columns in the table, along with the ORACLE storage type, the external format and character position that should be used if the information is provided in a flat file, and a short description of the column. For more detailed definitions of the columns, please see section 4.0.

affiliation

The **affiliation** table groups stations into networks. It contains station to array mapping.

Table 2.1: affiliation

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*net*	varchar2(8)	a8	1-8	unique network identifier
2	*sta*	varchar2(6)	a6	10-15	station identifier
3	*time*	float(53)	f17.5	17-33	starting *time* for station in network
4	*endtime*	float(53)	f17.5	35-51	*endtime* for station in network
5	*lddate*	date	a19	53-71	load date

Keys:	Primary	*net*/*sta*/*time*
Data:	Descriptive	*net, sta*
	Measurement	*time, endtime*
	Administrative	*lddate*

arrival

.

The **arrival** table contains summary information about arrivals.

Table 2.2: arrival

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*sta*	varchar2(6)	a6	1-6	station code
2	*time*	float(53)	f17.5	8-24	epoch time
3	*arid*	number(9)	i9	26-34	arrival identifier
4	*jdate*	number(8)	i8	36-43	julian date
5	*stassid*	number(9)	i9	45-53	arrival group identification
6	*chanid*	number(8)	i8	55-62	instrument identifier
7	*chan*	varchar2(8)	a8	64-71	channel code
8	*iphase*	varchar2(8)	a8	73-80	reported phase
9	*stype*	varchar2(1)	a1	82-82	signal type
10	*deltim*	float(24)	f6.3	84-89	time uncertainty
11	*azimuth*	float(24)	f7.2	91-97	observed azimuth
12	*delaz*	float(24)	f7.2	99-105	azimuth uncertainty
13	*slow*	float(24)	f7.2	107-113	observed slowness, seconds/degree
14	*delslo*	float(24)	f7.2	115-121	slowness uncertainty
15	*ema*	float(24)	f7.2	123-129	emergence angle
16	*rect*	float(24)	f7.3	131-137	rectilinearity
17	*amp*	float(24)	f11.2	139-149	amplitude, instrument corrected
18	*per*	float(24)	f7.2	151-157	period
19	*logat*	float(24)	f7.2	159-165	log (amp/per)
20	*clip*	varchar2(1)	a1	167-167	clipped flag
21	*fm*	varchar2(2)	a2	169-170	first motion
22	*snr*	float(24)	f10.2	172-181	signal-to-nose ratio
23	*qual*	varchar2(1)	a1	183-183	signal onset quality

Table 2.2: arrival

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
24	*auth*	varchar2(15)	a15	185-199	author
25	*commid*	number(9)	i9	201-209	comment identifier
26	*lddate*	date	a19	211-229	load date

Keys:	Primary	*arid*
	Unique	*sta/time/chan/iphase/auth*
	Foreign	*chanid, commid*
Data:	Descriptive	*sta, chan, iphase, stype*
	Measurement	*time, jdate, deltim, azimuth, delaz, slow, delslo, ema, rect, amp, per, logat, clip, fm, snr, qual*
	Administrative	*auth, lddate*

assoc

The **assoc** table contains information that connects arrivals (entries in the **arrival** table) to a particular origin.

Table 2.3: assoc

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*arid*	number(9)	i9	1-9	arrival identifier
2	*orid*	number(9)	i9	11-19	origin identifier
3	*sta*	varchar2(6)	a6	21-26	station code
4	*phase*	varchar2(8)	a8	28-35	associated phase
5	*belief*	float(24)	f4.2	37-40	phase confidence
6	*delta*	float(24)	f8.3	42-49	station-to-event distance
7	*seaz*	float(24)	f7.2	51-57	station-to-event azimuth
8	*esaz*	float(24)	f7.2	59-65	event-to-station azimuth
9	*timeres*	float(24)	f8.3	67-74	time residual
10	*timedef*	varchar2(1)	a1	76-76	time = defining (d), non-defining (n)
11	*azres*	float(24)	f7.1	78-84	azimuth residual
12	*azdef*	varchar2(1)	a1	86-86	azimuth = defining (d), nondefining (n)
13	*slores*	float(24)	f7.2	88-94	slowness residual
14	*slodef*	varchar2(1)	a1	96-96	slowness = defining (d), nondefining (n)
15	*emares*	float(24)	f7.1	98-104	incidence angle residual
16	*wgt*	float(24)	f6.3	106-111	location weight
17	*vmodel*	varchar2(15)	a15	113-127	velocity model
18	*commid*	number(9)	i9	129-137	comment identifier
19	*lddate*	date	a19	139-157	load date

Keys:	Primary	*arid*/*orid*
	Foreign	*commid*
Data:	Descriptive	*sta, phase belief, wgt, vmodel*
	Measurement	*delta, seaz, esaz, timeres, timedef, azres, azdef, slores, slodef, emares*
	Administrative	*lddate*

event

The **event** table contains a list of events. Multiple origins may be defined for any one event in the origin table. The column *prefor* points to the preferred origin.

Table 2.4: event

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*evid*	number(9)	i9	1-9	event identifier
2	*evname*	varchar2(32)	a32	11-42	event name
3	*prefor*	number(9)	i9	44-51	preferred origin
4	*auth*	varchar2(15)	a15	53-67	source/originator
5	*commid*	number(9)	i9	69-77	comment identifier
6	*lddate*	date	a19	79-97	load date

Keys:	Primary	*evid*
	Foreign	*prefor, commid*
Data:	Descriptive	*evname, prefor*
	Administrative	*auth, lddate*

instrument

The **instrument** table contains ancillary calibration information. It holds nominal one frequency calibration factors for each instrument and pointers to nominal frequency-dependent calibration for an instrument. This table also holds pointers to the exact calibrations obtained by direct measurement on a particular instrument (see **sensor**).

Table 2.5: instrument

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*inid*	number(8)	i8	1-8	instrument identifier
2	*insname*	varchar2(50)	a50	10-59	instrument name
3	*instype*	varchar2(6)	a6	61-66	instrument type
4	*band*	varchar2(1)	a1	68-68	frequency band
5	*digital*	varchar2(1)	a1	70-70	data type, digital (d) or analog (a)
6	*samprate*	float(24)	f11.7	72-82	sampling rate in samples/second
7	*ncalib*	float(24)	f16.6	84-99	nominal calibration (nanometers/digital count)
8	*ncalper*	float(24)	f16.6	101-116	nominal calibration period (seconds)
9	*dir*	varchar2(64)	a64	118-181	directory
10	*dfile*	varchar2(32)	a32	183-214	data file
11	*rsptype*	varchar2(6)	a6	216-221	response type
12	*lddate*	date	a19	223-241	load date

Keys:	Primary	*inid*
Data:	Descriptive	*insname, instype, band, digital, dir, dfile, rsptype*
	Measurement	*samprate, ncalib, ncalper*
	Administrative	*lddate*

netmag

The **netmag** table contains estimates of network magnitudes of different types for a given event. Each network magnitude has a unique *magid*. Station magnitudes used to compute the network magnitude are in the **stamag** table.

Table 2.6: netmag

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*magid*	number(9)	i9	1-9	network magnitude identifier
2	*net*	varchar2(8)	a8	11-18	unique network identifier
3	*orid*	number(9)	i9	20-28	origin identifier
4	*evid*	number(9)	i9	30-38	event identifier
5	*magtype*	varchar2(6)	a6	40-45	magnitude type (ms, mb, etc.)
6	*nsta*	number(8)	i8	47-54	number of stations used
7	*magnitude*	float(24)	f7.2	56-62	magnitude
8	*uncertainty*	float(24)	f7.2	64-70	magnitude uncertainty
9	*auth*	varchar2(15)	a15	72-86	source/originator
10	*commid*	number(9)	i9	88-96	comment identifier
11	*lddate*	date	a19	98-116	load date

Keys:	Primary	*magid*
	Unique	*magid*/*orid*
	Foreign	*evid, net, orid, commid*
Data:	Descriptive	*net, magtype*
	Measurement	*magnitude, nsta, uncertainty*
	Administrative	*lddate*

network

The **network** table contains general information about seismic networks (see **affiliation**).

Table 2.7: network

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*net*	varchar2(8)	a8	1-8	unique network identifier
2	*netname*	varchar2(80)	a80	10-89	network name
3	*nettype*	varchar2(4)	a4	91-94	network type (array, local, world-wide, etc.)
4	*auth*	varchar2(15)	a15	96-110	source/originator
5	*commid*	number(9)	i9	112-120	comment identifier
6	*lddate*	date	a19	122-140	load date

Keys:	Primary	*net*
	Foreign	*commid*
Data:	Descriptive	*net, netname, nettype*
	Administrative	*auth, lddate*

origerr

The **origerr** table contains summaries of confidence bounds in origin estimations. The measurement types are the elements of the location covariance matrix. The descriptive types give the uncertainties in location, depth and origin time. These quantities are calculated from the covariance matrix, assuming gaussian errors and a confidence level *conf*.

Table 2.8: origerr

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*orid*	number(9)	i9	1-9	origin identifier
2	*sxx*	float(24)	f15.4	11-25	covariance matrix element
3	*syy*	float(24)	f15.4	27-41	covariance matrix element
4	*szz*	float(24)	f15.4	43-57	covariance matrix element
5	*stt*	float(24)	f15.4	59-73	covariance matrix element
6	*sxy*	float(24)	f15.4	75-89	covariance matrix element
7	*sxz*	float(24)	f15.4	91-105	covariance matrix element
8	*syz*	float(24)	f15.4	107-121	covariance matrix element
9	*stx*	float(24)	f15.4	123-137	covariance matrix element
10	*sty*	float(24)	f15.4	139-153	covariance matrix element
11	*stz*	float(24)	f15.4	155-169	covariance matrix element
12	*sdobs*	float(24)	f9.4	171-179	standard error of observations
13	*smajax*	float(24)	f9.4	181-189	semi-major axis of error
14	*sminax*	float(24)	f9.4	191-199	semi-minor axis of error
15	*strike*	float(24)	f6.2	201-206	strike of the semi-major axis
16	*sdepth*	float(24)	f9.4	208-216	depth error

Table 2.8: origerr

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
17	*stime*	float(24)	f6.3	218-223	origin time error
18	*conf*	float(24)	f5.3	225-229	confidence
19	*commid*	number(9)	i9	231-239	comment identifier
20	*lddate*	date	a19	241-259	load date

Keys:	Primary	*orid*
	Foreign	*commid*
Data:	Descriptive	*sdobs, smajax, sminax, strike, sdepth, stime, conf*
	Measurement	*sxx, syy, szz, stt, sxy, sxz, syz, stx, sty, stz*
	Administrative	*lddate*

origin

The **origin** table contains information describing a derived or reported origin for a particular event.

Table 2.9: origin

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*lat*	float(24)	f11.4	1-11	estimated latitude
2	*lon*	float(24)	f11.4	13-23	estimated longitude
3	*depth*	float(24)	f9.4	25-33	estimated depth
4	*time*	float(53)	f17.5	35-51	epoch time
5	*orid*	number(9)	i9	53-61	origin identifier
6	*evid*	number(9)	i9	63-71	event identifier
7	*jdate*	number(8)	i8	73-80	julian date
8	*nass*	number(4)	i4	82-85	number of associated phases
9	*ndef*	number(4)	i4	87-90	number of locating phases
10	*ndp*	number(4)	i4	92-95	number of depth phases
11	*grn*	number(8)	i8	97-104	geographic region number
12	*srn*	number(8)	i8	106-113	seismic region number
13	*etype*	varchar2(7)	a7	115-121	event type
14	*depdp*	float(24)	f9.4	123-131	estimated depth from depth phases
15	*dtype*	varchar2(1)	a1	133-133	depth method used
16	*mb*	float(24)	f7.2	135-141	body wave magnitude
17	*mbid*	number(9)	i9	143-151	M_b magnitude identifier
18	*ms*	float(24)	f7.2	153-159	surface wave magnitude
19	*msid*	number(9)	i9	161-169	M_s magnitude identifier
20	*ml*	float(24)	f7.2	171-177	local magnitude
21	*mlid*	number(9)	i9	179-187	M_L magnitude identifier
22	*algorithm*	varchar2(15)	a15	189-203	location algorithm used

Table 2.9: origin

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
23	*auth*	varchar2(15)	a15	205-219	source/originator
24	*commid*	number(9)	i9	221-229	comment identifier
5	*lddate*	date	a19	231-249	load date

Keys:	Primary	*lat*/*lon*/*depth*/*time*/*auth*
	Unique	*orid*
	Foreign	*evid, mbid, msid, mlid, commid*
Data:	Descriptive	*nass, ndef, ndp, grn, srn, etype*
	Measurement	*lat, lon, depth, time, jdate, depdp, dtype, mb, mbid, ms, msid, ml, mlid*
	Administrative	*algorithm, auth, lddate*

remark

The **remark** table contains comments. This table may be used to store free-form comments that embellish records of other tables. The *commid* type in many tables refers to a record in the **remark** table. If *commid* is NA (-1) in a record of any other table, no comments are stored for that record.

Table 2.10: remark

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*commid*	number(9)	i9	1-9	comment identifier
2	*lineno*	number(8)	i8	11-18	comment line number
3	*remark*	varchar2(80)	a80	20-99	free-format comment
4	*lddate*	date	a19	101-119	load date

Keys:	Primary	*commid*/*lineno*
Data:	Descriptive	*lineno, remark*
	Administrative	*lddate*

sensor

The **sensor** table stores calibration information for specific sensor channels. This table provides a record of updates in the calibration factor or clock error of each instrument and links a *sta*/*chan*/*time* to a complete instrument response in the **instrument** table. Waveform data are converted into physical units through multiplication by the *calib* type located in **wfdisc**. The correct value of *calib* may not be accurately known when the **wfdisc** record is entered into the database. The **sensor** table provides the mechanism (*calratio* and *calper*) to update *calib*, without requiring possibly hundreds of **wfdisc** records to be updated. Through the foreign key *inid*, this table is linked to **instrument**, which has types pointing to flat files holding detailed calibration information in a variety of formats (see **instrument**).

Keys:	Primary	*sta*/*chan*/*time*/*endtime*
	Foreign	*inid, chanid*
Data:	Descriptive	*sta, chan, instant*
	Measurement	*time, endtime, jdate, calratio, calper, tshift*
	Administrative	*lddate*

site

The **site** table contains station location information. It names and describes a point on the earth where measurements are made (for example, the location of an instrument or array of instruments). This table contains information that normally changes infrequently, such as location. In addition, the **site** table contains types that describe the offset of a station relative to an array reference location. Global data integrity implies that the *sta*/*ondate* in **site** be consistent with the *sta*/*chan*/*ondate* in the **sitechan** table.

Table 2.12: site

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*sta*	varchar2(6)	a6	1-6	station identifier
2	*ondate*	number(8)	i8	8-15	julian start date
3	*offdate*	number(8)	i8	17-24	julian off date
4	*lat*	float(53)	f11.6	26-36	latitude
5	*lon*	float(53)	f11.6	38-48	longitude
6	*elev*	float(24)	f9.4	50-58	elevation
7	*staname*	varchar2(50)	a50	60-109	station description
8	*statype*	varchar2(4)	a4	111-114	station type (single station, array)
9	*refsta*	varchar2(6)	a6	116-121	reference station for array members
10	*dnorth*	float(24)	f9.4	123-131	offset from array reference (km)
11	*deast*	float(24)	f9.4	133-141	offset from array reference (km)
12	*lddate*	date	a19	143-161	load date

Keys:	Primary	*sta*/*ondate*
Data:	Descriptive	*sta, staname, statype, refsta*
	Measurement	*ondate, offdate, lat, lon, elev, dnorth, deast*
	Administrative	*lddate*

sitechan

The **sitechan** table contains station-channel information. It describes the orientation of a recording channel at the site referenced by *sta*. The table provides information about the various channels that are available at a station and maintains a record of the physical channel configuration at a site.

Table 2.13: sitechan

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*sta*	varchar2(6)	a6	1-6	station identifier
2	*chan*	varchar2(8)	a8	8-15	channel code
3	*ondate*	number(8)	i8	17-24	julian start date
4	*chanid*	number(8)	i8	26-33	channel identifier
5	*offdate*	number(8)	i8	35-42	julian off date
6	*ctype*	varchar2(4)	a4	44-47	channel type
7	*edepth*	float(24)	f9.4	49-57	emplacement depth
8	*hang*	float(24)	f6.1	59-64	horizontal angle
9	*vang*	float(24)	f6.1	66-71	vertical angle
10	*descrip*	varchar2(50)	a50	73-122	channel description
11	*lddate*	date	a19	124-142	load date

Keys:	Primary	*sta*/*chan*/*ondate*
	Unique	*chanid*
Data:	Descriptive	*sta, chan, ctype, descrip*
	Measurement	*ondate, offdate, edepth, hang, vang*
	Administrative	*lddate*

stamag

The **stamag** table contains station magnitude estimates based upon measurements made on specific seismic phases. Values in the **stamag** table are used to calculate network magnitudes stored in the **netmag** table.

Table 2.14: stamag

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*magid*	number(9)	i9	1-9	magnitude identifier
2	*ampid*	number(9)	i9	11-19	amplitude identifier
3	*sta*	varchar2(6)	a6	21-26	station code
4	*arid*	number(9)	i9	28-36	arrival identifier
5	*orid*	number(9)	i9	38-46	origin identifier
6	*evid*	number(9)	i9	48-56	event identifier
7	*phase*	varchar2(8)	a8	58-65	associated phase
8	*delta*	float(24)	f8.3	67-74	station-to-event distance
9	*magtype*	varchar2(6)	a6	76-81	magnitude type (ml, ms, mb, etc)
10	*magnitude*	float(24)	f7.2	83-89	magnitude
11	*uncertainty*	float(24)	f7.2	91-97	magnitude uncertainty
12	*magres*	float(24)	f7.2	99-105	magnitude residual
13	*magdef*	varchar2(1)	a1	107-107	d or n flag indicating if magnitude is defining or nondefining
14	*mmodel*	varchar2(15)	a15	109-123	magnitude model
15	*auth*	varchar2(15)	a15	125-139	author
16	*commid*	number(9)	i9	141-149	comment identifier
17	*lddate*	date	a19	53-71	load date

Keys:	Primary	*magid*/*sta*/*arid*
	Foreign	*arid, orid, evid, commid*
Data:	Descriptive	*delta, sta, phase, magtype, magdef, mmodel*
	Measurement	*magnitude, uncertainty, magres*
	Administrative	*auth, lddate*

wfdisc

The **wfdisc** table contains a waveform header file and descriptive information. This table provides a pointer (or index) to waveforms stored on disk. The waveforms themselves are stored in ordinary disk files as a sequence of sample values (usually in binary representation).

Table 2.15: wfdisc

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*sta*	varchar2(6)	a6	1-6	station code
2	*chan*	varchar2(8)	a8	8-15	channel code
3	*time*	float(53)	f17.5	17-33	epoch time of first sample in file
4	*wfid*	number(9)	i9	35-43	waveform identifier
5	*chanid*	number(8)	i8	45-52	channel identifier
6	*jdate*	number(8)	i8	54-61	julian date
7	*endtime*	float(53)	f17.5	63-79	*time* +(*nsamp* -1)/samples
8	*nsamp*	number(8)	i8	81-88	number of samples
9	*samprate*	float(24)	f11.7	90-100	sampling rate in samples/sec
10	*calib*	float(24)	f16.6	102-117	nominal calibration
11	*calper*	float(24)	f16.6	119-134	nominal calibration period
12	*instype*	varchar2(6)	a6	136-141	instrument code
13	*segtype*	varchar2(1)	a1	143-143	indexing method
14	*datatype*	varchar2(2)	a2	145-146	numeric storage
15	*clip*	varchar2(1)	a1	148-148	clipped flag
16	*dir*	varchar2(64)	a64	150-213	directory
17	*dfile*	varchar2(32)	a32	215-246	data file
18	*foff*	number(10)	i10	248-257	byte offset of data segment within file
19	*commid*	number(9)	i9	259-267	comment identifier
20	*lddate*	date	a19	269-287	load date

Keys:	Primary	*wfid*/*dir*/*dfile*
	Unique	*wfid*
	Foreign	*chanid*, *commid*
Data:	Descriptive	*sta, chan, dir, dfile, foff*
	Measurement	*time, jdate, endtime, nsamp, samprate, calib, calper, instype, segtype, datatype, clip*
	Administrative	*lddate*

wftag

The **wftag** table links various identifiers with specific waveforms, for example, *orid, arid,* and *stassid* to *wfid*. Linkages can also be determined indirectly using *sta*/*chan*/*time*; however, it is more efficient to use the **wftag** table.

Table 2.16: wftag

FIELD NUMBER	COLUMN	STORAGE TYPE	EXTERNAL FORMAT	CHARACTER POSITION	DESCRIPTION
1	*tagname*	varchar2(8)	a8	1-8	key (*arid, orid, evid*, etc.)
2	*tagid*	number(9)	i9	10-18	tagname value
3	*wfid*	number(9)	i9	20-28	waveform identifier
4	*lddate*	date	a19	30-48	load date

Keys:	Primary	*tagname*/*tagid*/*wfid*
Data:	Descriptive	*tagname*
	Administrative	*lddate*

3.0 Table Relationships

The entity-relationship diagrams (ERDs) in this section use the graphical conventions shown in Table 3.1 to describe relationships, table names, keys, and columns. The table is always shown at the top of the table symbol. Keys, if present, are shown below the table name. The primary key of a table is indicated with a black star (★), and the unique key of a table is indicated with a black star with a white dot (✯). Foreign keys are indicated with a white star (☆). Keys consisting of multiple columns are shown with a key symbol next to all the columns that make up that key. All column names, if present, are shown below the key section of the diagrams. Furthermore, the primary key, commid, of the **remark** table is not explicitly drawn in the tables in which it appears as a foreign key. This section uses the graphical symbols described in Table 3.1.

Table 3.1: Entity-relationship graphical symbols

Description	Symbol
One A maps to one B	A ◄——► B
One A maps to zero or one B	A ◄——○► B
One A maps to many Bs	A ◄——►► B
One A maps to zero or many Bs	A ◄——○►► B
Database table	**table name** ★ unique key ☆ foreign key column 1 column 2 . . column n

Relationships between tables are established by primary and foreign keys. Table 3.2 explains the syntax used. In many cases, the column names in the two tables are not identical or a column value in one table must be compared to more than one column value in another table. The delimiters in the syntax are the dash (-) and the slash (/). A dash (-) separates groups of column names from the two tables and a slash(/) separates

Table 3.2: Syntax Used to Indicate Database Table Relationships

SYNTAX	DEFINITION
col	This is the simplest case where the column names (*col*) of the keys are the same at each end of the relationship. Both keys consist of a single column
col1/*col2*	A slash (/) is used when a key is comprised of multiple columns. Here, the keys in both tables are the same and consist of two columns, *col1* and *col2*
col1-col2	A dash (-) is used when the column names of the keys in the two tables are not the same. *Col1* is the name of the key column in one table and *col2* is the name of the key column in the other. Each key consists of a single column. Only one dash may be used and the dash separates the keys of the two tables. A dash can be combined with a slash (/) to show that the keys consist of multiple columns and that one or more of the columns have different names in the two tables, as in *col1*/*col2*-*col3*/*col4* (both parts of the key are different in the two tables) or *col1*/*col2*-*col1*/*col3* (only the second part of the key is different in the two tables)
col1-col2/*col3*=`value`	An equal sign (=) is used when a component of a key must be set to a particular value. Here *col1* is the name of the key column in one column. *Col2* and *col3* must be set to the shown value. See the *arid-tagid*/*tagname*=`arid` relationship between **arrival** and **wftag** and *orid-tagid*/*tagname*=`orid` relationship between **origin** and **wftag**
col1-col2&*col3*	An ampersand (&) is used to show that a key in one table may have a value between the values of two keys in another table. Here the value of *col1* must be between the values of *col2* and *col3*. See the *sta*/*chan*/*time-sta*/*chan*/*time*&*endtime* relationship between **wfdisc** and **sensor**

composite key columns. Other symbols, such as equal (=), and ampersand (&) specify how the columns are compared. The order of operations is = and &.

Some of the entity-relationship diagrams show multiple relationships between two tables. For example, there are two relationships between the **origin** and **event** tables in Figure 1; a many-to-zero or many-to-one relationship through *evid* and a zero-to-one or one-to-one relationship through *prefor-orid*. The *evid* relationship states that for every **origin** entry, there is zero or one corresponding entry in **event** where the *evid* in **origin** equals the *evid* in **event**, and for every **event** entry, there are many **origin** entries where the *evid* in **event** equals the *evid* in **origin**. The *prefor-orid* relationship states that for every **origin**

entry, there is zero or one corresponding entry in **event** where the *orid* in **origin** equals the *prefor* in **event**, and for every **event** entry, there is one **origin** entry where the *prefor* in **event** equals the *orid* in **origin**.

3.1 Primary Tables

Figure 1 shows the summary of the Primary tables and keys. Each of these tables is involved in preserving origin hypothesis and events. Figures 2, 3 and 4 describe these tables in detail.

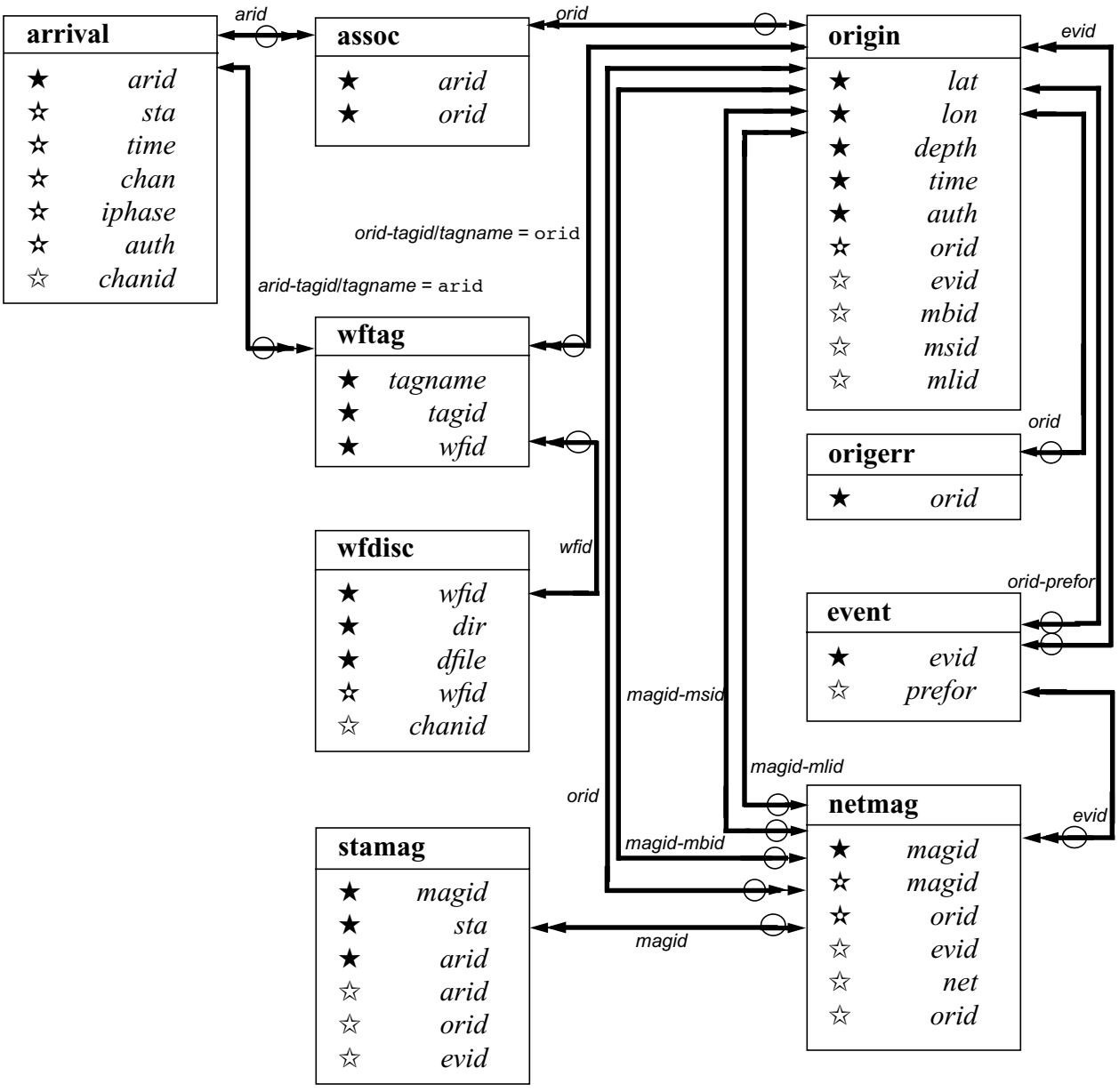

Figure 1. Relationships between Primary Tables

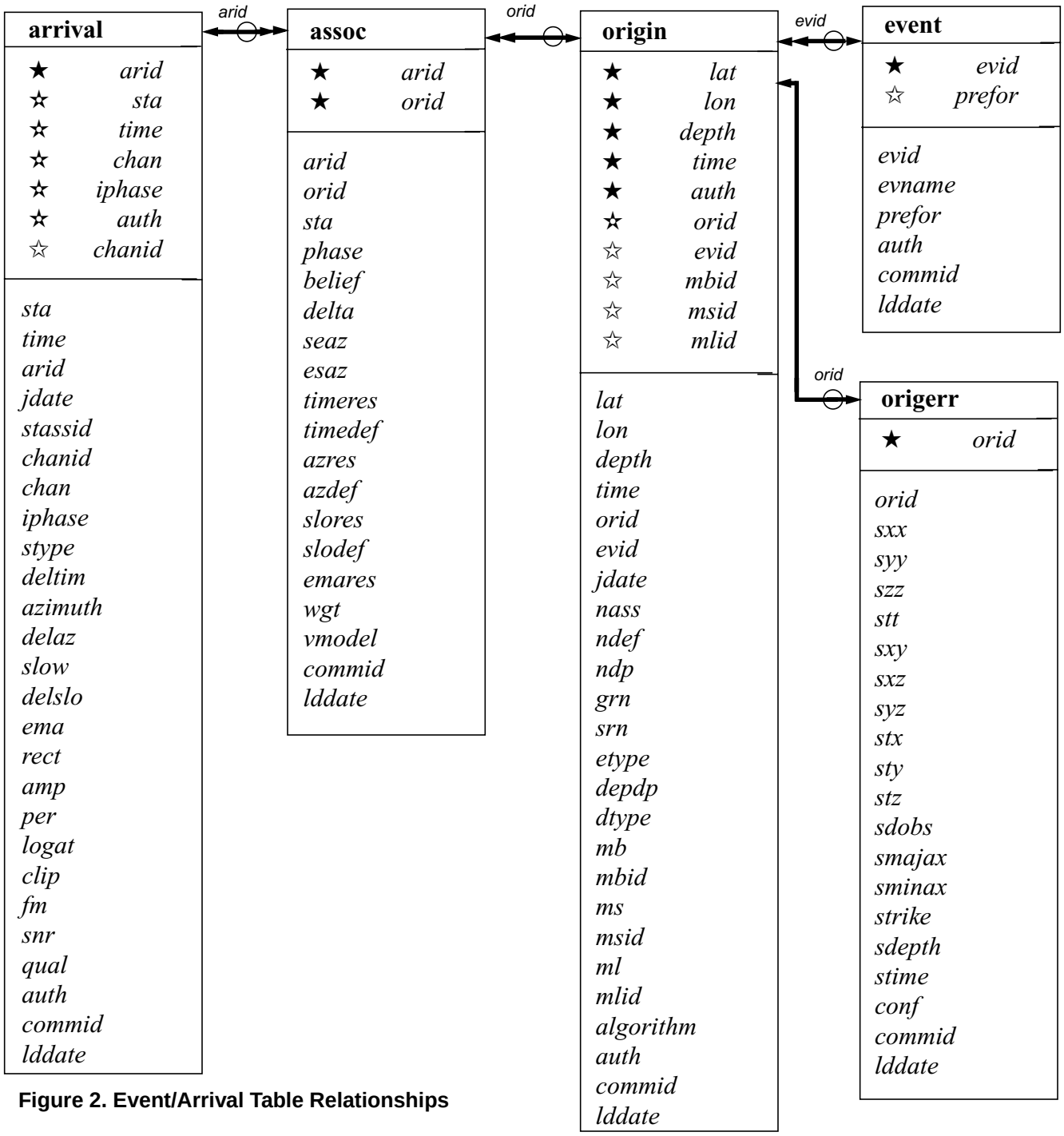

Figure 2. Event/Arrival Table Relationships

Figure 2 shows the relationships between the event and arrival table. Arrivals in the **arrival** table are associated with different origin hypotheses from the **origin** table through the **assoc** table. Based on seismic signal measurements, groups of arrivals are associated with presumed events. Each event may have many different origin hypotheses, each with a different event location estimate. The preferred origin hypothesis is specified in the **event** table as a *prefor*.

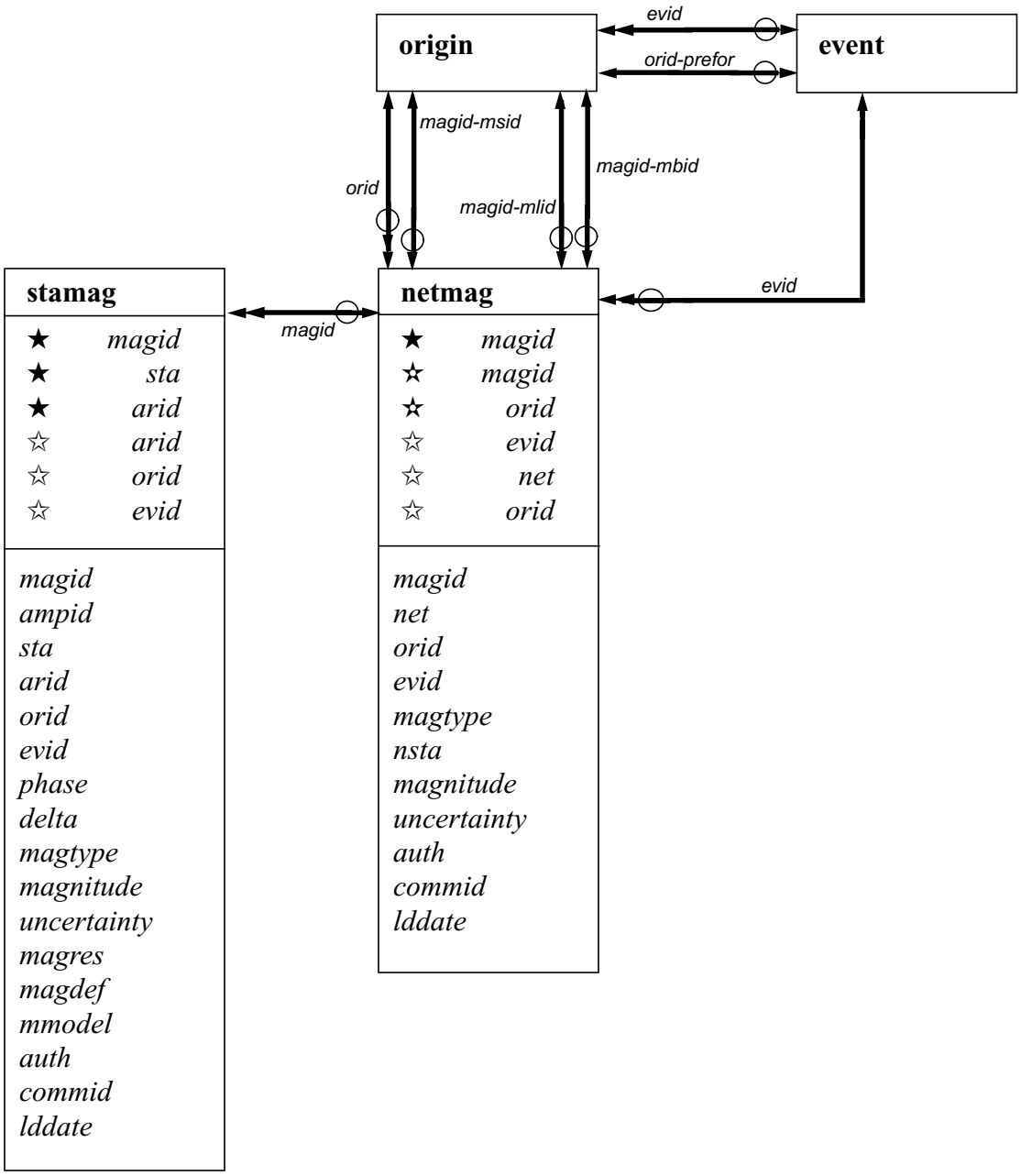

Figure 3. Magnitude Table Relationships

Figure 3 shows the relationships between the magnitude tables. The **stamag** table contains station magnitude estimates based upon measurements made on specific seismic phases. Values in the **stamag** table are used to calculate network magnitudes stored in the **netmag** table. The **netmag** table contains estimates of network magnitudes of different types for an event in the **event** table. Each network magnitude has a unique *magid* that relates to either a body wave magnitude (m_b), surface wave magnitude (M_s) or a local magnitude (M_L) through the columns *mbid*, *msid* or *mlid*.

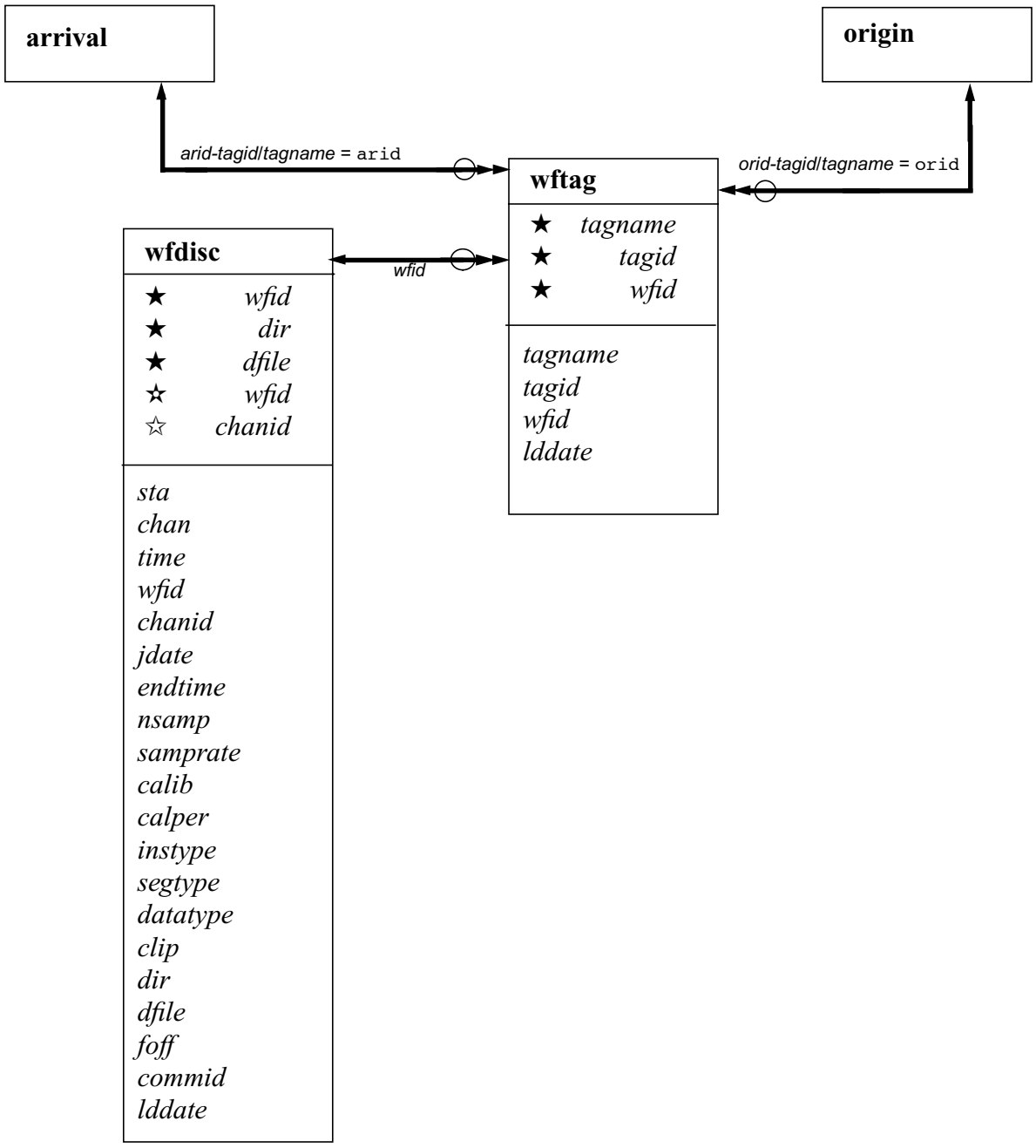

Figure 4. Waveform Table Relationships

Figure 4 shows the waveform tables **wfdisc** and **wftag**. The waveforms themselves are stored in the flat files on the disk. They are usually called ".w" files and are a sequence of a sample values (usually in a binary representation). The descriptive information on the waveforms is stored in the **wfdisc** table, which provides a pointer (or index) to the waveforms on the disk. The **wfdisc** table is linked to the **arrival** and **origin** tables through *sta*, *chan*, and *time*. The **wftag** table specifies which table the **wfdisc** record is linked to, **origin** or **arrival**.

3.2 Lookup tables

The Lookup tables are fairly static and primarily contain look-up information. Figure 5 is an overview of these tables. Three primary tables (**arrival**, **assoc** and **origin**) are also shown since these tables link directly to the lookup tables. Figures 6 and 7 describe the tables in detail.

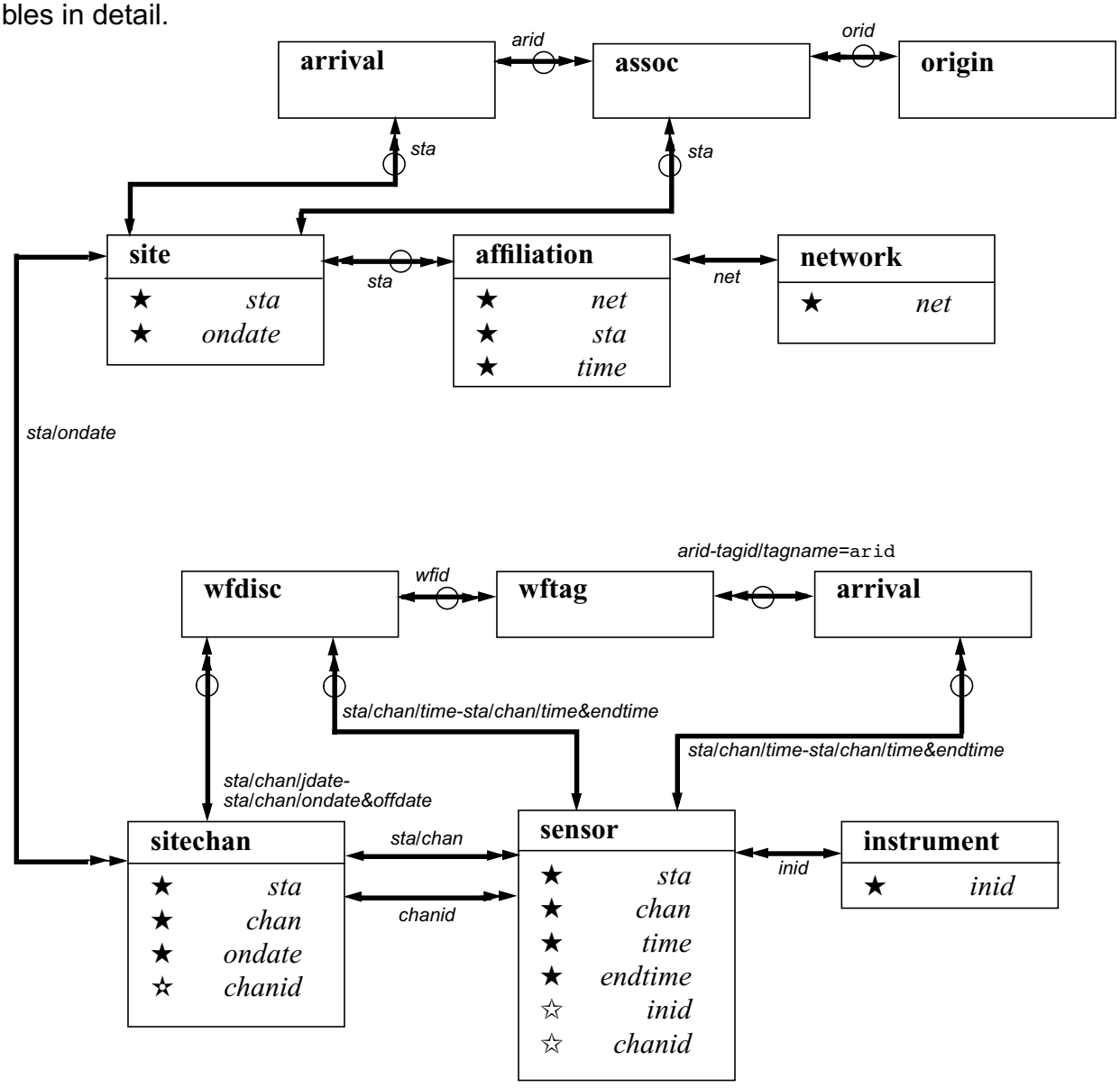

Figure 5. Lookup Table Relationships

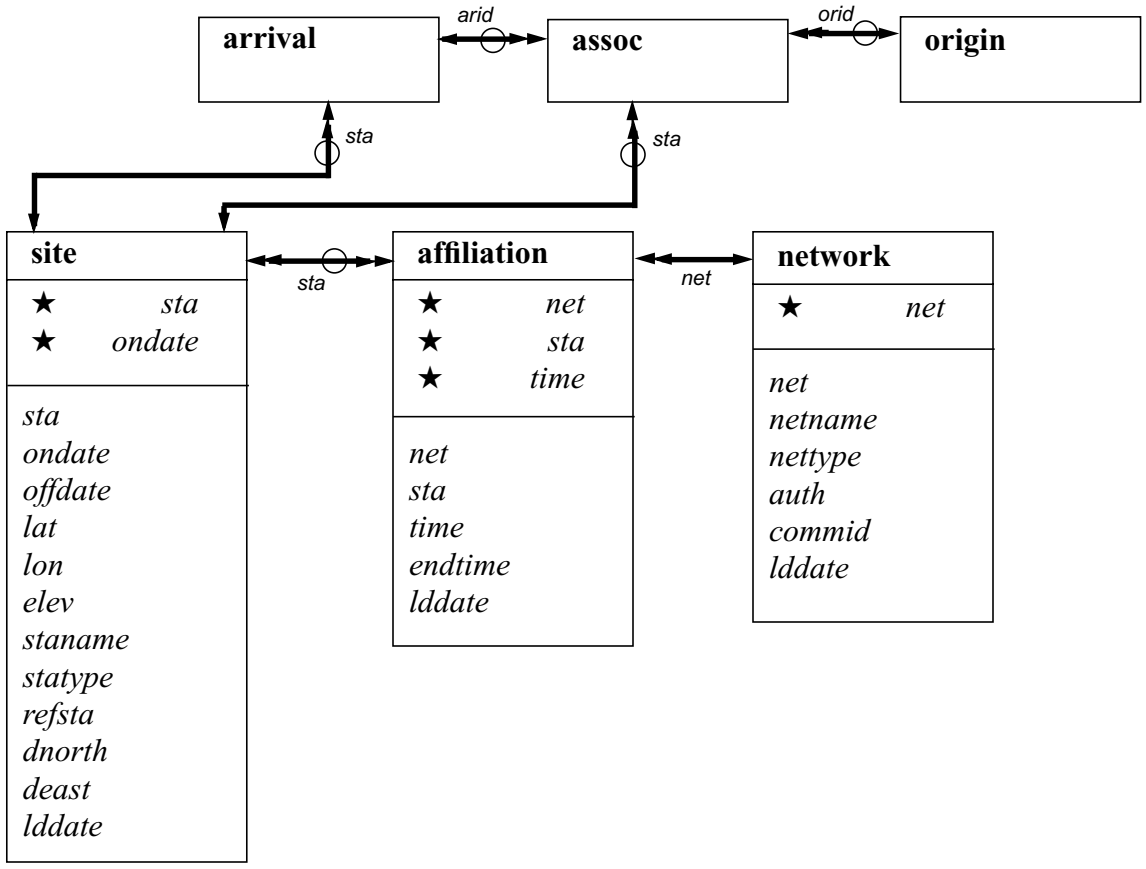

Figure 6. Network Table Relationships

Figure 6 shows tables related to networks. The **site** table contains station location information. It describes the geographic location of a station. The **site** table also contains fields that describe the offset of a station relative to an array reference location. The **affiliation** table groups stations across wide geographic areas as networks and to group the elements of arrays to the name of the array. The general information about the seismic networks is stored in the **network** table.

Figure 7 shows tables that contain specific information about station channels. It is linked to the **site** table through the **sitechan** table, which contains station-channel information. Detailed calibration information is stored in flat files, in a variety of formats. The **instrument** table holds complete instrument response information, including ancillary calibration information and pointers to the flat files with detailed instrument responses. The

instrument identifier *inid* links the **instrument** table to the **sensor** table. The **sensor** table contains calibration information for specific sensor channels and is linked to the **wfdisc** and **arrival** tables through *sta*/*chan*/*time*. It provides instrument update records, using the calibration period column *calper*, thus linking a *sta*/*chan*/*time* to a complete instrument response.

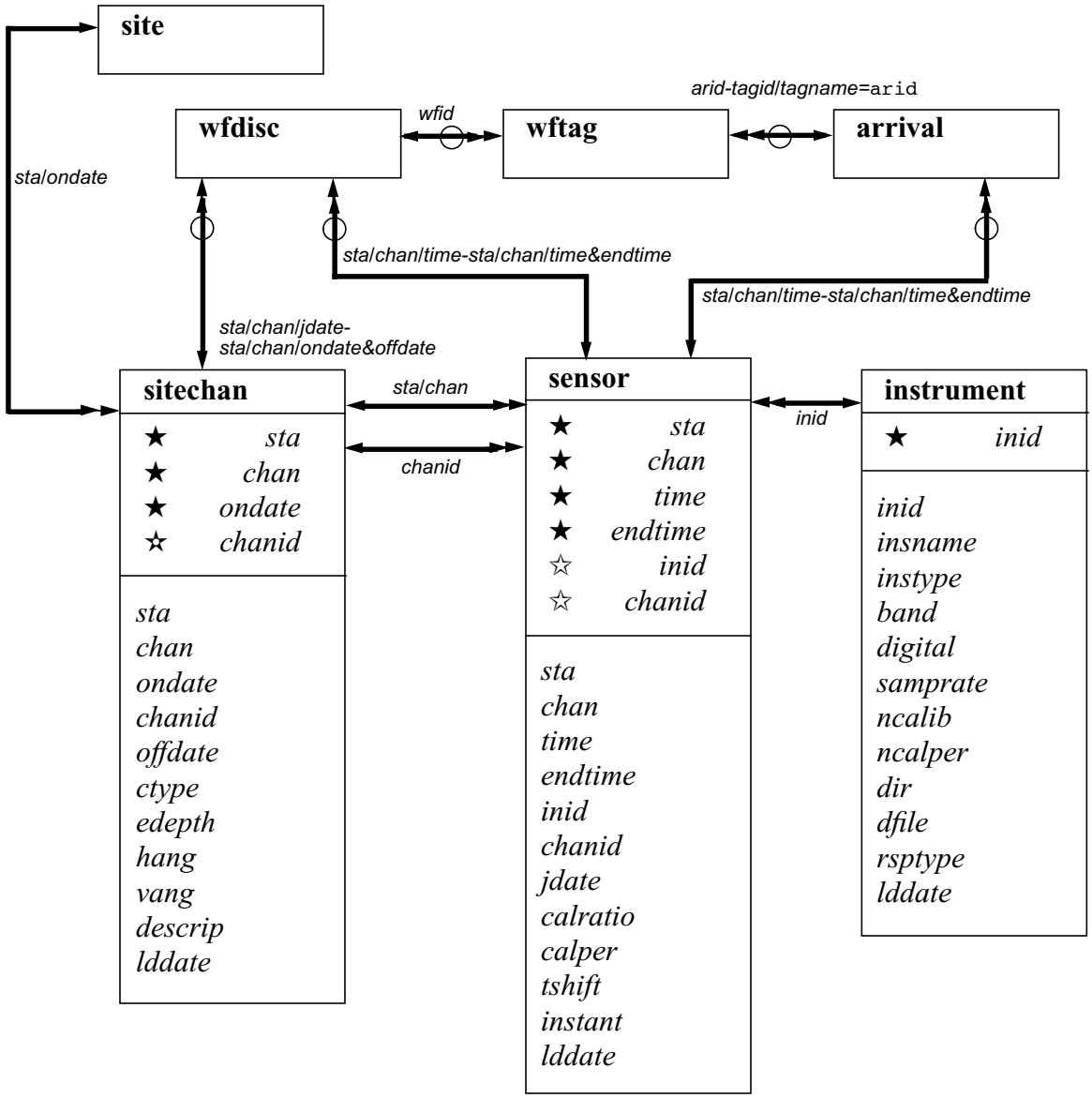

Figure 7. Channel Table Relationships

4.0 Column Descriptions

This section describes the columns used in the NNSA Core Table Database Schema. Descriptions of the tables are found in Section 2.0. Each column is described with the following attributes:

Name: name of the column (shown in *italics*)

Table: table(s) which contain the column (shown in **bold**)

Description: column description

Format: ORACLE data type

We are using four of the available data types in ORACLE.

- VARCHAR2: All character data less that 256 characters in the database are defined to be VARCHAR2(n) where “n” is the number of characters in the string
- NUMBER: All integer fields in the database are defined to be Number(n) where “n” is the number of digits allowed in the number
- FLOAT: All real number fields in the database are defined to be FLOAT(24) or FLOAT(53). The ORACLE FLOAT(n) type, where “n” is the number of binary digits allowed in the number, allows the approximation of single and double precision floats commonly used in scientific programming.
- DATE: The only field in the database that is declared to be the ORACLE DATE data type is lddate, which stores the day and time a record was inserted into the database.

NA Value: A value that is used to indicate that information is not available for this column. The NA Value should be used when the actual value is not known and alerts users and applications that the desired column was not available when the record was created. Essential attributes that must always be given a value are documented with an NA Value of NOT ALLOWED. The following table lists the convention we tried to follow when assigning NA Values.

Column type/range	NA Value	Examples
characters (varchar)	- (hyphen)	*auth*
non-negative integers	-1	*chanid, arid*
non-negative real numbers	-1.0	*cfreq, deltim*
real numbers > -999.0	-999.0	*azres*

Column type/range	NA Value	Examples
large real numbers	+/- 9999999999.999	*endtime, time*

An NA Value should not be confused with an ORACLE NULL. NA Values are supplied by users, while ORACLE inserts the database value NULL when no value is specified. A column containing a database value of NULL appears blank when selected within SQL*Plus. When creating a table, a column may be constrained as NOT NULL to require the user to supply a value. The ORACLE describe command will identify such columns as NOT NULL. No correlation is intended between ORACLE NOT NULL requirements and the requirements that a column must be specified.

Units: Units of measure, if applicable

Range: The range of permissible or recommended values for this column. Whenever possible an explicit range is defined. The range is important for data integrity and database management systems that automatically check ranges. When the range consists of a relatively small number of discreet values, the following notation is used (values in courier font):

column ∈{`value-1, value-2, ...., value-n`}

No range is documented for columns whose value may be any character string.

The *time* attribute throughout the database is stored as epochal time, the number of seconds since January 1, 1970. Epochal time has a precision of 1 millisecond. Often *time* is matched by the more readable jdate. This so-called “Julian date” represents a day in the form, for example 1981231 where 1981 is the year (YYYY) and 231 is the day of year (DOY).

4.1 Column Definitions

Name:	*algorithm*	
Table:	**origin**	
Description:	Location algorithm used. This column is a brief textual description of the algorithm used for computing a seismic origin.	
Format:	varchar2(15)	External: a15
NA Value:	- (hyphen)	
Range:	any character string up to the column size	

Name:	*amp*
Table:	**arrival**

Name:	*azdef*
Table:	**assoc**
Description:	Azimuth-defining code; one-character flag indicates whether or not the azimuth of a phase was used to constrain the event location solution. This column is defining (*azdef* = d) if it was used in the location, nondefining (*azdef* = n) if it was not.
Format:	varchar2(1) External: a1
NA Value:	- (hyphen)
Range:	*azdef* ∈ {d, n}

Name:	*azimuth*
Table:	**arrival**
Description:	Observed azimuth. This value is the estimated station-to-event azimuth measured clockwise from North. The estimate is made from f-k or polarization analysis.
Format:	float(24)
NA Value:	-1.0 External: f7.2
Units:	degrees
Range:	0.0 ≤ *azimuth* < 360.0

Name:	*azres*
Table:	**assoc**
Description:	Azimuth residual. This value is the difference between the measured station-to-event azimuth for an arrival and the true azimuth. The true azimuth is the bearing to the inferred event origin.
Format:	float(24) External: f7.1
NA Value:	-999.0
Units:	degrees
Range:	-180.0 ≤ *azres* ≤ 180.0

Name:	*band*
Table:	**instrument**
Description:	Frequency band. This value is a qualitative indicator of frequency passband for an instrument. Values should reflect the response curve rather than just the sample rate. Recommended values are as follows: s (short-period) m (mid-period) i (intermediate-period) l (long-period) b (broadband) h (high-frequency, very short-period) v (very long-period) For a better notion of the instrument characteristics, see the instrument response curve.
Format:	varchar2(1) External: a1
NA Value:	- (hyphen)
Range:	*band* ∈ {s, m, i, l, b, h, v}

Name: *belief*

Table: **assoc**

Description: Phase identification confidence level. This value is a qualitative estimate of the confidence that a seismic phase is correctly identified.

Format: float(24) External: f4.2

NA Value: -1.0

Range: 0.0 ≤ *belief* ≤ 1.0

Name: *calib*

Table: **wfdisc**

Description: Calibration factor. This value is the conversion factor that maps digital data to earth displacement. The factor holds true at the oscillation period specified by the column *calper*. A positive value means ground motion increasing in component direction (up, North, East) is indicated by increasing counts. A negative value means the opposite. The column *calib* generally reflects the best calibration information available at the time of recording, but refinement may be given in **sensor**, reflecting a subsequent recalibration of the instrument (see *calratio*).

Format: float(24) External: f16.6

NA Value: NOT ALLOWED

Units: Nanometers/digital count

Range: *calib* > 0.0

Name: *calper*

Table: **sensor, wfdisc**

Description: Calibration period; gives the period for which *calib*, *ncalib*, and *calratio* are valid.

Format: float(24) External: f16.6

NA Value: NOT ALLOWED

Units: seconds

Range: *calper* > 0.0

Name: *calratio*

Table: **sensor**

Description: Calibration conversion ratio. The value is a dimensionless calibration correction factor that permits small refinements to the calibration correction made using *calib* and *calper* from the **wfdisc** table. Often, the **wfdisc** *calib* contains the nominal calibration assumed at the time of data recording. If the instrument is recalibrated, *calratio* provides a mechanism to update calibrations from **wfdisc** with the new information without modifying the **wfdisc** table. A positive value means ground motion increasing in component direction (up, North, East) is indicated by increasing counts. A negative value means the opposite. The column *calratio* is meant to reflect the most accurate calibration information for the time period for which the sensor record is appropriate, but the nominal value may appear until other information is available.

Format: float(24) External: f16.6

NA Value: NOT ALLOWED

Range: *calratio* > 0.0

Name:	*chan*	
Table:	**arrival, sensor, sitechan, wfdisc**	
Description:	Channel code; an eight-character code which, taken together with *sta*, *jdate* and *time*, uniquely identifies seismic time-series data, including the geographic location, spatial orientation, sensor, and subsequent data processing (beam channel descriptor)	
Format:	varchar2(8)	External: a8
NA Value:	NOT ALLOWED except in **arrival** where - (hyphen) is allowed	
Range:	any character string up to the column size	

Name:	*chanid*	
Table:	**arrival, sensor, sitechan, wfdisc**	
Description:	Channel identifier. This value is a surrogate key used to uniquely identify a specific recording. The column *chanid* duplicates the information of the compound key *sta*/*chan*/*time*.	
Format:	number(8)	External: i8
NA Value:	-1	
Range:	*chanid* > 0	

Name:	*clip*	
Table:	**arrival, wfdisc**	
Description:	Clipped data flag. This value is a single-character flag to indicate whether (`c`) or not (`n`) the data was clipped	
Format:	varchar2(1)	External:
NA Value:	- (hyphen)	
Range:	*clip* ∈ {c, n}	

Name:	*commid*	
Table:	**arrival, assoc, event, netmag, network, origerr, origin, remark, stamag, wfdisc**	
Description:	Comment identifier. This value is a key that points to free-form comments entered in the **remark** table. These comments store additional information about a record in another table. The **remark** table can have many records with the same *commid* and different *lineno*, but the same *commid* will appear in only one other record among the rest of the tables in the database (see *lineno*).	
Format:	number(9)	External: i9
NA Value:	-1, NOT ALLOWED for **remark**	
Range:	*commid* > 0	

Name:	*conf*	
Table:	**origerr**	
Description:	Confidence measure for a particular event identification method	
Format:	float(24)	External: f5.3
NA Value:	NOT ALLOWED	
Range:	0.5 ≤ *conf* ≤ 1.0	

Name: *ctype*

Table: **sitechan**

Description: Channel type. This column specifies the type of data channel: normal (n) -- a normal instrument response, beam (b) -- a coherent beam formed with array data, or incoherent (i) -- an incoherent beam or energy stack.

Format: varchar2(4) External: a4

NA Value: - (hyphen)

Range: *ctype* ∈ {n, b, i}

Name: *datatype*

Table: **wfdisc**

Description: Station to event distance

Format: varchar2(2) External: a2

NA Value: - (hyphen)

Range: *datatype* ∈ {a0, b0, c0, a#, b#, c#, t4, t8, s4, s2, s3, f4, f8, i4, i2, e#, g2}

Value	Size(bytes)	Description
a0	15	ASCII single precision
b0	24	ASCII double precision
c0	12	ASCII integer
a#	15	ASCII single precision
b#	24	ASCII double precision
c#	12	ASCII integer
t4	4	SUN Institute of Electrical and Electronics Engineers (IEEE) single precision real
t8	8	SUN IEEE double precision real
s4	4	SUN IEEE integer
s2	2	SUN IEEE short integer
s3	3	SUN IEEE integer
f4	4	VAX IEEE single precision real
f8	8	VAX IEEE double precision real
i4	4	VAX IEEE integer
i2	2	VAX IEEE short integer
e#	2048*#	Compressed data format
g2	2	Norwegian Regional Experimental Seismic System (NORESS) gain-ranged

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Name: *deast*

Table: **site**

Description: Distance East. This column gives the easting or the relative position of an array element East of the location of the array center specified by the value of *refsta* (see *dnorth*).

Format: float(24) External: f9.4

NA Value: 0.0

Units: kilometers

Range: -20,000.0 ≤ *deast* ≤ 20,000.0

Name:	*delaz*	
Table:	**arrival**	
Description:	Azimuth uncertainty. This column is an estimate of the standard deviation of the azimuth of a signal	
Format:	float(24)	External: f9.4
NA Value:	-1.0	
Units:	degrees	
Range:	*delaz* > 0	

Name:	*delslo*	
Table:	**arrival**	
Description:	Slowness uncertainty. This column is an estimate of the standard deviation of the slowness of a signal	
Format:	float(24)	External: f7.2
NA Value:	-1.0	
Units:	seconds/degree	
Range:	*delslo* > 0.0	

Name:	*delta*	
Table:	**assoc, stamag**	
Description:	Source-receiver distance. This column is the arc length, over the Earth s surface, of the path the seismic phase follows from source to receiver. The location of the origin is specified in the **origin** record referenced by the column *orid*. The column *arid* points to the record in the **arrival** table that identifies the receiver. The value of the column can exceed 360 degrees. The geographic distance between source and receiver is delta modulo(180).	
Format:	float(24)	External: f8.3
NA Value:	-1.0	
Units:	degrees	
Range:	*delta* ≥ 0.0	

Name:	*deltim*	
Table:	**arrival**	
Description:	Arrival time uncertainty. This column is an estimate of the standard deviation of an arrival time.	
Format:	float(24)	External: f6.3
NA Value:	-1.0	
Units:	seconds	
Range:	*deltim* > 0.0	

Name:	*depdp*	
Table:	**origin**	
Description:	Depth as estimated from depth phases. This value is a measure of event depth estimated from a depth phase or an average of several depth phases. Depth is measured positive in a downwards direction, starting from the Earth s surface (see ndp).	
Format:	float(24)	External: f9.4
NA Value:	-999.0	
Units:	kilometers	
Range:	*0.0* ≤ *depdp* ≤ 1000.0	

Name:	*depth*	
Table:	**origin**	
Description:	Source depth. This column gives the depth (positive down) of the event origin. Negative depth implies an atmospheric event.	
Format:	float(24)	External: f9.4
NA Value:	-999.0	
Units:	kilometers	
Range:	-100.0 ≤ *depth* ≤ 1000.0	

Name:	*descrip*	
Table:	**sitechan**	
Description:	Text description	
Format:	varchar2(50)	External: a50
NA Value:	- (hyphen)	
Range:	any character string up to the column size	

Name:	*dfile*	
Table:	**instrument, wfdisc**	
Description:	Name of data file.	
Format:	varchar2(32)	External: a32
NA Value:	NOT ALLOWED	
Range:	any character string up to the column size that conforms to UNIX filename syntax	

Name:	*digital*	
Table:	**instrument**	
Description:	Flag denoting whether this instrument record describes an analog (a) or digital (d) recording system	
Format:	varchar2(1)	External: a1
NA Value:	- (hyphen)	
Range:	*digital* ∈ {d, a}	

Name: *dir*

Table: **instrument, wfdisc**

Description: Directory. This column is the directory part of a path name. Relative path names or dot (.), the notation for the current directory, may be used.

Format: varchar2(64) External: a64

NA Value: NOT ALLOWED

Range: any character string up to the column size that conforms to UNIX directory name syntax

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Name: *dnorth*

Table: **site**

Description: Distance North. This column gives the northing or relative position of array element North of the array center specified by the value of *refsta* (see *deast*).

Format: float(24) External: f9.4

NA Value: 0.0

Units: kilometers

Range: -20,000.0 ≤ *dnorth* ≤ 20,000.0

Name: *dtype*

Table: **origin**

Description: Depth determination flag. This single-character flag indicates the method by which the depth was determined or constrained during the location process. The following *dtypes* are defined: `A` (assigned), `D` (depth restrained > 2pP phases), `N` (restrained to normal depth - 33 km), `G` (restrained by geophysicist), `S` (depth control aided by S phase), `q` (questionable value), `L` (less reliable - 8.5-16 km 90% conf), `P` (poor depth estimate - > 16 km error), `F` (good depth estimate - < 8.5 km). The *auth* column should indicate the agency or person responsible for this action, or the *commid* column should point to an explanation in the **remark** table.

Format: varchar2(1) External: a1

NA Value: not allowed

Range: *dtype* ∈ {`A`, `D`, `N`, `G`, `S`, `q`, `L`, `P`, `F`}

Name: *edepth*

Table: **sitechan**

Description: Emplacement depth at which instrument is positioned relative to the value of *elev* in the **site** table

Format: float(24) External: f9.4

NA Value: NOT ALLOWED

Units: kilometers

Range: *edepth* ≥ 0.0

Name:	*elev*
Table:	**site**
Description:	Surface elevation. This column is the elevation of the surface of the earth above the seismic station (**site**) relative to mean sea level
Format:	float(24) External: f9.4
NA Value:	-999.0
Units:	kilometers
Range:	-10.0 ≤ *elev* ≤ 10.0

Name:	*ema*
Table:	**arrival**
Description:	Emergence angle. This column is the emergence angle of an arrival as observed at a 3-component station or array. The value increases from the vertical direction towards the horizontal.
Format:	float(24) External: f7.2
NA Value:	-1.0
Units:	degrees
Range:	0.0 ≤ *ema* ≤ 90.0

Name:	*emares*
Table:	**assoc**
Description:	Emergence angle residual. This column is the difference between an observed emergence angle and the theoretical prediction for the same phase, assuming an event location as specified by the accompanying *orid*.
Format:	float(24) External: f7.1
NA Value:	-999.0
Units:	degrees
Range:	-90.0 ≤ *emares* ≤ 90.0

Name:	*endtime*
Table:	**affiliation, sensor, wfdisc**
Description:	Epoch time. Epoch time is given as seconds and fractions of a second since hour 0 January 1, 1970 and stored in a double-precision floating number.
Format:	float(53) External: f17.5
NA Value:	+9999999999.999
Units:	seconds
Range:	*time* < *endtime* < +9999999999.999

Name:	*esaz*
Table:	**assoc**
Description:	Event to station azimuth measured in degrees clockwise from north.
Format:	float(24) External: f7.2
NA Value:	-999.0
Units:	degrees
Range:	0.0 ≤ *esaz* < 360.0

Name:	*etype*
Table:	**origin**
Description:	An event type that is used to identify the type of seismic event, when known. The recommended event types are: `ex` generic explosion ec chemical explosion `ep` probable explosion `en` nuclear explosion `mc` collapse `me` coal bump/mining event `mp` probable mining event `mb` rock burst `qt` generic earthquake/tectonic `qd` damaging earthquake `qp` unknown-probable earthquake `qf` felt earthquake `ge` geyser `xm` meteroritic origin `xl` ligts `xo` odors
Format:	varchar2(7) External: a7
NA Value:	- (hyphen)
Range:	*etype* ∈ {`ex`, `ec`, `ep`, `en`, `mc`, `me`, `mp`, `mb`, `qt`, `qd`, `qp`, `qf`, `ge`, `xm`, `xl`, `xo`}

Name:	*evid*
Table:	**event, netmag, origin, stamag**
Description:	Event identifier. Each event is assigned a unique positive integer that identifies it in a database. Several records in the **origin** table can have the same *evid*. Analysts have several opinions about the location of the event.
Format:	number(9) External: i9
NA Value:	-1 NOT ALLOWED for **event**
Range:	*evid* > 0

Name:	*evname*
Table:	**event**
Description:	Event name. This is the common name of the event identified by *evid*.
Format:	varchar2(32 External a32)
NA Value:	- (hyphen)
Range:	any character string up to the column size

Name:	*fm*
Table:	**arrival**
Description:	First motion. This is a two-character indication of first motion. The first character describes first motion seen on short-period channels and the second holds for long-period instruments. Compression on a short-period sensor is denoted by `c` and dilation by `d`. Compression on a long- period sensor is denoted by `u` and dilation by `r`. Empty character positions will be indicated by dots (for example, `.r` for dilitation on a long-period sensor).
Format:	varchar2(2) External: a2
NA Value:	- (hyphen)
Range:	*fm* ∈ all two letter permutations of {c, d,.}, {u, r,.}

Name:	*foff*	
Table:	**wfdisc**	
Description:	File offset; the byte offset of a data segment within a physical data file. This column is non-zero if the data reference does not occur at the beginning of the file.	
Format:	number(10)	External: i10
NA Value:	NOT ALLOWED	
Range:	*foff* ≥ 0	

Name:	*grn*	
Table:	**origin**	
Description:	Geographic region number.	
Format:	number(8)	External: i8
NA Value:	-1	
Range:	1 ≤ *esaz* ≤ 729	

Name:	*hang*	
Table:	**sitechan**	
Description:	Horizontal orientation of seismometer. This column specifies the orientation of the seismometer in the horizontal plane, measured clockwise from North. For a North-South orientation with the seismometer pointing toward the North, *hang* = 0.0 For East-West orientation with the seismometer pointing toward the West, *hang* = 270.0 (see *vang*)	
Format:	float(24)	External: f6.1
NA Value:	NOT ALLOWED	
Units:	degrees	
Range:	0.0 ≤ *hang* ≤ 360.0	

Name:	*inid*	
Table:	**instrument, sensor**	
Description:	Instrument identifier. This column is a unique key to the **instrument** table. The *inid* column provides the only link between **sensor** and **instrument**.	
Format:	number(8)	External: i8
NA Value:	NOT ALLOWED -1 for **sensor**	
Range:	*inid* > 0	

Name:	*insname*	
Table:	**instrument**	
Description:	Instrument name. This character string contains the name of the instrument.	
Format:	varchar2(50)	External: a50
NA Value:	- (hyphen)	
Range:	any character string up to the column size	

Name: *instant*

Table: **sensor**

Description: Snapshot indicator. When instant = `y`, the snapshot was taken at the time of a discrete procedural change, such as an adjustment of the instrument gain; when instant = `n`, the snapshot is of a continuously changing process, such as calibration drift. This value is important for tracking time corrections and calibrations. The default value is `y`.

Format: varchar2(1) External: a1

NA Value: NOT ALLOWED

Range: *instant* ∈ {y, n}

Name: *instype*

Table: **instrument, wfdisc**

Description: Instrument type. This character string is used to indicate the instrument type (for example, `SRO, ASRO, DWWSSN, LRSM`, and `S-750`).

Format: varchar2(6) External: a6

NA Value: - (hyphen)

Range: any upper-case character string up to the column size

Name: *iphase*

Table: **arrival**

Description: Reported phase. This eight-character column holds the name initially given to a seismic phase. Standard seismological labels for the types of signals (or phases) are used (for example, `P, PKP, PcP, pP`). Both upper- and lower-case letters are available and should be used when appropriate [for example, `pP` or `PcP` (see *phase*)].

Format: varchar2(8) External: a8

NA Value: - (hyphen)

Range: any character string up to the column size that conforms to seismological practice

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Name: *jdate*

Table: **arrival, origin, sensor, wfdisc**

Description: Julian date. Date of an arrival, origin, seismic recording, etc. The same information is available in epoch time, but the Julian date format is more convenient for many types of searches. Dates B.C. are negative. The year will never equal 0000, and the day will never equal 000. Where only the year is known, the day of the year is 001; where only year and month are known, the day of year is the first day of the month. Only the year is negated for B.C., so 1 January of 10 B.C. is 0010001 (see *time*).

Format: number(8) External: i8

NA Value: -1

Range: Julian dates are of the form yyyyddd; must be consistent with the accompanying time column

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Name:	*lat*	
Table:	**origin, site**	
Description:	Geographic latitude. Locations north of equator have positive latitudes.	
Format:	float(53)	External: f11.6
NA Value:	-999.0	
Units:	degrees	
Range:	-90.0 ≤ *lat* ≤ 90.0	

Name:	*lddate*	
Table:	**affiliation, arrival, assoc, event, instrument, netmag, network, origerr, origin, remark, sensor, site, sitechan, stamag, wfdisc, wftag**	
Description:	Load date. The date and time the record was inserted into the database.	
Format:	date	External: a19
NA Value:	NOT ALLOWED	
Range:	any valid ORACLE date	

Name:	*lineno*	
Table:	**remark**	
Description:	Line number. This number is assigned as a sequence number for multiple line comments.	
Format:	number(8)	External i8
NA Value:	NOT ALLOWED	
Range:	*lineno* > 0	

Name:	*logat*	
Table:	**arrival**	
Description:	Log of amplitude divided by period. This measurement of signal size is often reported instead of the amplitude and period separately. This column is only filled if the separate measurements are not available.	
Format:	float(24)	External f7.2
NA Value:	-999.0	
Range:	*logat* > 0.0	

Name:	*lon*	
Table:	**origin, site**	
Description:	Geographic longitude. Longitudes are measured positive East of the Greenwich meridian.	
Format:	float(53)	External:f11.6
NA Value:	-999.0	
Units:	degrees	
Range:	-180.0 ≤ *lon* ≤ 180.0	

Name:	*magdef*	
Table:	**stamag**	
Description:	Magnitude defining switch. This one-character flag indicating whether or not a station magnitude for a given **stamag** record was used in determining the network magnitude. This column is defining (magdef = `d`) if it is used in network magnitude calculation or nondefining (magdef = `n`) if it is not used.	
Format:	varchar2(1)	External: a1
NA Value:	- (hyphen)	
Range:	*magdef* ∈ {d, n}	

Name:	*magid*	
Table:	**netmag, stamag**	
Description:	Network magnitude identifier. This value is assigned to identify a network magnitude in the **netmag** table. This column is required for every network magnitude. Magnitudes given in **origin** must reference a network magnitude with *magid* = *mbid*, *mlid* or *msid*, whichever is appropriate (see *mbid*, *mlid*, or *msid*).	
Format:	number(9)	External: i9
NA Value:	NOT ALLOWED	
Range:	*magid* > 0	

Name:	*magnitude*	
Table:	**netmag, stamag**	
Description:	Magnitude. This column gives the magnitude value of the type indicated in *magtype*. The value is derived in a variety of ways, which are not necessarily linked directly to an arrival (see *magtype*, *mb*, *ml*, and *ms*).	
Format:	float(24)	External: f7.2
NA Value:	NOT ALLOWED -999.0 for **netmag**	
Units:	magnitude	
Range:	-9.99 < *magnitude* < 50.0	

Name:	*magres*	
Table:	**stamag**	
Description:	Magnitude residual. Difference between the magnitude for a given stamag record and network magnitude	
Format:	float(24)	External: f7.2
NA Value:	-999.0	
Units:	magnitude	
Range:	-10.0 < *magnitude* < 10.0	

Name:	*magtype*	
Table:	**netmag, stamag**	
Description:	Magnitude type (for example, *mb*).	
Format:	varchar2(6)	External: a6
NA Value:	NOT ALLOWED	
Range:	any magnitude type up to the column size	

Name: *mb*

Table: **origin**

Description: Body wave magnitude, m_b [**origin**]. This is the body wave magnitude of an event. The identifier *mbid* that points to *magid* in the **netmag** table is associated with this column. The information in that record summarizes the method of analysis and data used (see *magnitude*, *magtype*, *ml*, and *ms*).

Format: float(24) External: f7.2

NA Value: -999.0

Units: magnitude

Range: -9.99 < *mb* < 50.00

Name: *mbid*

Table: **origin**

Description: Magnitude identifier for *mb*. This attribute stores the *magid* for a record in **netmag**. The identifier *mbid* is a foreign key joining **origin** to **netmag** where **origin**.*mbid* = **netmag**.*magid* (see *magid*, *mlid*, and *msid*).

Format: number(9) External: i9

NA Value: -1

Range: *mbid* > 0

Name: *ml*

Table: **origin**

Description: Local magnitude (M_L) of an event. The identifier *mlid*, which points to *magid* in the **netmag** tables, is associated with this column. The information in that record summarizes the method of analysis and the data used (see *magnitude*, *magtype*, *mb*, and *ms*).

Format: float(24) External: f7.2

NA Value: -999.0

Units: magnitude

Range: -9.99 < *ml* < 50.00

Name: *mlid*

Table: **origin**

Description: Magnitude identifier for local magnitude (M_L). This attribute stores the *magid* for a record in **netmag**. The identifier *mlid* is a foreign key joining **origin** to **netmag** where **origin**.*mlid* = **netmag**.*magid* (see *magid*, *mbid*, and *msid*).

Format: number(9) External: i9

NA Value: -1

Range: *mbid* > 0

Name: *mmodel*
Table: **stamag**
Description: Magnitude model. This character string identifies the magnitude model employed for station (stamag) or overall network magnitude calculation. In stamag, mmodel is the unique magnitude model as extracted from the magnitude correction file.
Format: varchar2(15) External: a15
NA Value: - (hyphen)
Range: any character string up to the column size

Name: *ms*
Table: **origin**
Description: This is the surface wave magnitude for an event. The identifier *msid*, which points to *magid* in the **netmag** table, is associated with this column. The information in that record summarizes the method of analysis and the data used (see *magnitude*, *magtype*, *mb*, and *ml*).
Format: float(24) External: f7.2
NA Value: -999.0
Units: magnitude
Range: -9.99 < *ms* < 50.00

Name: *msid*
Table: **origin**
Description: Magnitude identifier for *ms*. This attribute stores the *magid* for a record in **netmag**. The identifier *msid* is a foreign key joining **origin** to **netmag** where **origin**.*msid* = **netmag**.*magid* (see *magid*, *mbid*, and *mlid*).
Format: number(9) External: i9
NA Value: -1
Range: *msid* > 0

Name: *nass*
Table: **origin**
Description: Number of associated arrivals. This column gives the number of arrivals associated with the origin
Format: number(4) External: i4
NA Value: -1
Range: *nass* > 0

Name:	*ncalib*	
Table:	**instrument**	
Description:	Nominal calibration factor. This conversion factor maps digital data to earth displacement. The factor holds true at the oscillation period specified by *ncalper*. A positive value means ground motion increasing in component direction (up, North, East) is indicated by increasing counts. A negative value means the opposite. Actual calibration for a particular recording is determined using the **wfdisc** and **sensor** tables (see *calratio*).	
Format:	float(24)	External: f16.6
NA Value:	NOT ALLOWED	
Units:	nanometers/digital count	
Range:	*ncalib* ≠ 0	

Name:	*ncalper*	
Table:	**instrument**	
Description:	Calibration period. This column is the period for which *ncalib* is valid	
Format:	float(24)	External: f16.6
NA Value:	NOT ALLOWED	
Range:	*ncalper* > 0.0	

Name:	*ndef*	
Table:	**origin**	
Description:	Number of time-defining phases	
Format:	number(4)	External: i4
NA Value:	-1	
Range:	0 < *ndef* ≤ *nass*	

Name:	*ndp*	
Table:	**origin**	
Description:	Number of depth phases. This column gives the number of depth phases used in calculating *depth*/*depdp* (see *depdp*)	
Format:	number(4)	External: i4
NA Value:	-1	
Range:	*ndp* ≥ 0	

Name:	*net*	
Table:	**affiliation, netmag, network**	
Description:	Unique network identifier. This character string is the name of a seismic network (for example, WWSSN).	
Format:	varchar2(8)	External: a8
NA Value:	NOT ALLOWED - (hyphen) for **netmag**	
Range:	any character string up to the column size	

Name:	*netname*
Table:	**network**
Description:	Network name. This character string contains the name of a network.
Format:	varchar2(80) External: a80
NA Value:	- (hyphen)
Range:	any character string up to the column size

Name:	*nettype*
Table:	**network**
Description:	Network type. This four-character string specifies the type of network [array (ar), local area (lo), world-wide (ww) for the given value of *net*]
Format:	varchar2(4) External: a4
NA Value:	- (hyphen)
Range:	any lower-case character string up to the column size

Name:	*nsamp*
Table:	**wfdisc**
Description:	Number of samples. This quantity is the number of samples in a waveform segment.
Format:	number(8) External: i8
NA Value:	NOT ALLOWED
Range:	*nsamp* > 0

Name:	*nsta*
Table:	**netmag**
Description:	Number of stations. This column is the number of stations contributing to the network magnitude estimate.
Format:	number(8) External: i8
NA Value:	-1
Range:	*nsta* > 0

Name:	*offdate*
Table:	**site, sitechan**
Description:	Turn off date. This column is the Julian Date on which the station or sensor indicated was turned off, dismantled, or moved (see *ondate*)
Format:	number(8) External: i8
NA Value:	-1
Range:	Julian date of the form yyyyddd

Name:	*ondate*
Table:	**site, sitechan**
Description:	Turn on date. Date on which the archive specifications, regional coefficient, station, sensor, or subscription indicated became applicable or began operating. The columns *offdate* and *ondate* are not intended to accommodate temporary downtimes, but rather to indicate the time period for which the columns of the station (*lat*, *lon*, *elev*) are valid for the given station code. Stations are often moved, but with the station code remaining unchanged.
Format:	number(8) External: i8
NA Value:	NOT ALLOWED
Range:	Julian date of the form yyyyddd

Name:	*orid*
Table:	**assoc, netmag, origerr, origin, stamag**
Description:	Origin identifier that. relates a record in these tables to a record in the **origin** table
Format:	number(9) External: i9
NA Value:	NOT ALLOWED
Range:	*orid* > 0

Name:	*per*
Table:	**arrival**
Description:	Measured period at the time of the amplitude measurement
Format:	float(24) External: f7.2
NA Value:	-999.0
Units:	seconds
Range:	*per* > 0.0

Name:	*phase*
Table:	**assoc, stamag**
Description:	Phase type. The identity of a phase that has been associated to an arrival. Standard labels for phases are used (for example, `P, PKP, PcP, pP`, etc.). Both upper- and lower-case letters are available and should be used when appropriate (for example, `pP` or `PcP`).
Format:	varchar2(8) External: a8
NA Value:	- (hyphen)
Range:	any character string up to the column size that conforms to seismological practice

Name:	*prefor*
Table:	**event**
Description:	Preferred origin. This column holds the origin identifier (*orid*) that points to the preferred origin for a seismic **event**.
Format:	number(9) External: i9
NA Value:	NOT ALLOWED
Range:	*prefor* > 0

Name: *qual*

Table: **arrival**

Description: Onset quality. This single -character flag is used to denote the sharpness of the onset of a seismic phase. This relates to the timing accuracy as follows:
`i` (impulsive) accurate to ±0.2 seconds
`e` (emergent) accuracy between ±(0.2 to 1.0 seconds)
`w` (weak) timing uncertain to > 1 second.

Format: varchar2(1) External: a1

NA Value: -1 (hyphen)

Range: *qual* ∈ {i, e, w, 1,2,3,4}

Name: *rect*

Table: **arrival**

Description: Signal rectilinearity defined as:
$1 - (l_3 + l_2)/2l_1$
where l_1, l_2, and l_3 are the three eigenvalues from the decomposition of the covariance matrix. This value is the maximum rectilinearity for all overlapping time windows

Format: float(24) External: f7.3

NA Value: -1.0

Range: 0.0 < *rect* < 1.0

Name: *refsta*

Table: **site**

Description: Reference station. This string specifies the reference station with respect to which array members are located (see *deast*, *dnorth*).

Format: varchar2(6) External: a6

NA Value: - (hyphen)

Range: any character string up to the column size

Name: *remark*

Table: **remark**

Description: Descriptive text. This single line of text is an arbitrary comment about a record in the database. The comment is linked to its parent table only by forward reference from *commid* in the record of the table of interest. (see *commid*, *lineno*)

Format: varchar2(80) External: a80

NA Value: - (hyphen)

Range: any character string up to the column size

Name: *rsptype*

Table: **instrument**

Description: Instrument response type. This value denotes the style in which detailed calibration data is stored. The neighboring column *dfile* tells where the calibration data is saved.
rsptype = `paz` indicates the data is the poles and zeroes of the Laplace transform
rsptype = `fap` indicates the data is amplitude/phase values at a range of frequencies
rsptype = `fir` indicates that the response type is a finite impulse response table
rsptype = `pazfir` indicates a combination of poles, zeros, and finite impulse response
Other codes may be defined.

Format: varchar2(6) External: a6

NA Value: NOT ALLOWED

Range: any lower-case character string up to the column size

Name: *samprate*

Table: **instrument, wfdisc**

Description: Sampling rate. This column is the sample rate in samples per second. In the **instrument** table, the column value is specifically the nominal sample rate, not accounting for clock drift. In **wfdisc**, the value may vary slightly from the nominal to reflect clock drift.

Format: float(24) External: f11.7

NA Value: NOT ALLOWED

Units: 1/second

Range: *samprate* > 0.0

Name: *sdepth*

Table: **origerr**

Description: Depth error. This is the maximum error of a depth estimate for a level of confidence given by *conf* (see *smajax*, *sminax*, and *sxx*, *syy*, *szz*, *stt*, *sxy*, *sxz*, *syz*, *stx*, *sty*, *stz*)

Format: float(24) External: f9.4

NA Value: -1.0

Units: kilometers

Range: *sdepth* > 0.0

Name: *sdobs*

Table: **origerr**

Description: Standard error of one observation. This column is derived from the discrepancies in the arrival times of the phases used to locate an event. This column is defined as the square root of the sum of the squares of the time residuals divided by the number of degrees of freedom. The latter is the number of defining observations [*ndef* in **origin**] minus the dimension of the system solved (`4` if depth is allowed to be a free variable, `3` if depth is constrained).

Format: float(24) External: f9.4

NA Value: -1.0

Range: *samprate* > 0.0

Name:	*seaz*	
Table:	**assoc**	
Description:	Station-to-event azimuth calculated from the station and event locations and measured clockwise from north.	
Format:	float(24)	External: f7.2
NA Value:	-999.0	
Units:	degrees	
Range:	0.0 ≤ *seaz* ≤ 360.0	

Name:	*segtype*	
Table:	**wfdisc**	
Description:	Segment type. This column indicates if a waveform is `o` (original), `v` (virtual), `s` (segmented), or `d` (duplicate)	
Format:	varchar2(1)	External: a1
NA Value:	- (hyphen)	
Range:	*segtype* ∈ {o, v, s, d}	

Name:	*slodef*	
Table:	**assoc**	
Description:	Slowness defining code. This one-character flag indicates whether or not the slowness of a phase was used to constrain the event location. This column is defining (slodef = `d`) or non-defining (slodef = `n`) for this arrival.	
Format:	varchar2(1)	External: a1
NA Value:	- (hyphen)	
Range:	*slodef* ∈ {d, n} 0	

Name:	*slores*	
Table:	**assoc**	
Description:	Slowness residual. This column gives the difference between an observed slowness and a theoretical prediction. The prediction is calculated for the related phase and event origin described in the record.	
Format:	float(24)	External: f7.2
NA Value:	-999.0	
Units:	seconds/degree	
Range:	*slores* > -999.0	

Name:	*slow*	
Table:	**arrival**	
Description:	Observed slowness of a detected arrival	
Format:	float(24)	External: f7.2
NA Value:	-1.0	
Units:	seconds/degree	
Range:	slow ≥ 0.0	

Name: *smajax*
Table: **origerr**
Description: Semi-major axis of error ellipse for a given confidence. This value is the length of the semi-major axis of the location error ellipse. The value is found by projecting the covariance matrix onto the horizontal plane. The level of confidence is specified by *conf* (see *sdepth*, *sminax*, and *sxx*, *syy*, *szz*, *stt*, *sxy*, *sxz*, *syz*, *stx*, *sty*, *stz*).
Format: float(24) External: f9.4
NA Value: -1.0
Units: kilometers
Range: *smajax* > 0.0

Name: *sminax*
Table: **origerr**
Description: Semi-minor axis of error ellipse. This value is the length of the semi-minor axis of the location error ellipse. The value is found by projecting the covariance matrix onto the horizontal plane. The level of confidence is specified by *conf* (see *sdepth*, *smajax*, and *sxx*, *syy*, *szz*, *stt*, *sxy*, *sxz*, *syz*, *stx*, *sty*, *stz*).
Format: float(24) External: f9.4
NA Value: -1.0
Units: kilometers
Range: sminax > 0.0

Name: *snr*
Table: **arrival**
Description: Signal-to-noise ratio. This is an estimate of the ratio of the amplitude of the signal to amplitude of the noise immediately preceding it. This column is the average signal-to-noise ratio for the frequency bands that contributed to the final polarization estimates.
Format: float(24) External: f10.2
NA Value: -1.0
Range: *snr* > 0.0

Name: *srn*
Table: **origin**
Description: Seismic region number (see *grn*).
Format: number(8) External: i8
NA Value: -1
Range: 1 ≤ *seaz* ≤ 50

Name: *sta*

Table: **affiliation, arrival, assoc, sensor, site, sitechan, stamag, wfdisc**

Description: Station code. This is the code name of a seismic observatory and identifies a geographic location recorded in the **site** table.

Format: varchar2(6) External: a6

NA Value: NOT ALLOWED

Range: any upper-case character string up to the column size

Name: *staname*

Table: **site**

Description: Station name/Description:. This value is the full name of the station whose code name is in sta [for example, one record in the site table connects sta = ANMO to staname = ALBUQUERQUE, NEW MEXICO (SRO)].

Format: varchar2(50) External: a50

NA Value: - (hyphen)

Range: any upper-case character string up to the column size

Name: *stassid*

Table: **arrival**

Description: Identification of a group of arrivals from the same station originating from the same event

Format: number(9) External: i9

NA Value: -1

Range: *stassid* > 0

Name: *statype*

Table: **site**

Description: Station type; character string specifies the station type. Recommended entries are single station (`ss`) or array (`ar`).

Format: varchar2(4) External: a4

NA Value: - (hyphen)

Range: *statype* ∈ {ss, ar}

Name: *stime*

Table: **origerr**

Description: Origin time error. This column denotes the time uncertainty that accompanies the average error ellipse location (see *smajax*, *sminax*, and *sdepth*).

Format: float(24) External: f6.3

NA Value: -1.0

Units: seconds

Range: *stime* ≥ 0.0

Name: *strike*

Table: **origerr**

Description: Strike of major axis of error ellipse. This column is the strike of the semi-major axis of the location error ellipse, measured in degrees clockwise from the North (see *smajax*).

Format: float(24) External: f6.2

NA Value: -1.0

Units: degrees

Range: 0.0 ≤ *strike* ≤ 360.0

Name: *stype*

Table: **arrival**

Description: Signal type. This single-character flag indicates the event or signal type. The following definitions hold:

`l` =	Local event
`r` =	Regional event
`t` =	Teleseismic event
`m` =	Mixed or multiple event
`g` =	Glitch (for example, non-seismic detection)
`e` =	Calibration activity obfuscated the data
`l`, `r`, and `t`	Supplied by the reporting station or as an output of post-detection processing
`g` and `e`	Come from analyst comment or from status bits from GDSN and RSTN data

Format: varchar2(1) External: a1

NA Value: - (hyphen)

Range: *stype* ∈ {l, r, t, m. g. e}

Name: *sxx, syy, szz, stt, sxy, sxz, syz, stx, sty, stz*

Table: **origerr**

Description: Elements of the covariance matrix for the location identified by *orid*. The covariance matrix is symmetric (and positive definite) so that *sxy* = *syx*, and so on, (x, y, z, t) refer to latitude, longitude, depth, and origin time, respectively. These columns (together with *sdobs*, *ndef*, and *dtype*) provide the information necessary to construct the K-dimensional (K = 2, 3, 4) confidence ellipse or ellipsoids at any confidence limit desired.

Format: float(24) External: f15.4

NA Value: -1.0

Units: *sxx*, *syy*, *szz*, *sxy*, *sxz*, *syz* - kilometers squared (km^2)
stt - seconds squared (sec^2)
stx, *sty*, *stz* - kilometers per second (km/sec)

Range: *sxx, syy, szz, stt* > 0.0

Name:	*tagid*	
Table:	**wftag**	
Description:	Tagname value. This column contains the value of a foreign key identified in tagname [for example, if *tagname* is `arid`, then **wftag** may be joined to **arrival** where **arrival**.*arid* = **wftag**.*tagid*. If *tagname* is `orid`, then **wftag** and **origin** may be joined where **origin**.*orid* = **wftag**.*tagid*.]	
Format:	number(9)	External: i9
NA Value:	-999	
Units:	NOT ALLOWED	
Range:	*tagid* > 0	

Name:	*tagname*	
Table:	**wftag**	
Description:	Tagname type. This value is the name of the foreign key whose value is in tagid	
Format:	varchar2(8)	External: a8
NA Value:	NOT ALLOWED	
Range:	*tagname* ∈ {arid, evid, orid, stassid}	

Name:	*time*	
Table:	**affiliation, arrival, origin, sensor, wfdisc**	
Description:	Epoch time, given as seconds since midnight, January 1, 1970, and stored in a double-precision floating number. Time refers to the table in which it is found [for example, in **arrival** it is the arrival time, in **origin** it is the origin time, and in **wfdisc** it is the start time of data]. Where the date of historical events is known, time is set to the start time of that date. Where the date of contemporary arrival measurements is known but no time is given, then time is set to the NA Value. The double- precision floating point number allows 15 decimal digits. At one millisecond accuracy, this is a range of 3 *10 4 years. Where the date is unknown or prior to February 10, 1653, time is set to the NA Value.	
Format:	float(53)	External: f17.5
NA Value:	NOT ALLOWED	
Units:	second	
Range:	*time* > -9999999999.999	

Name:	*timedef*	
Table:	**assoc**	
Description:	Time-defining code. This one-character flag indicates whether or not the time of a phase was used to constrain the event location. This column is defining (timedef = `d`) or nondefining (timedef = `n`).	
Format:	varchar2(1)	External: a1
NA Value:	- (hyphen)	
Range:	*timedef* ∈ {n, d}	

Name: *timeres*

Table: **assoc**

Description: Time residual. This column is a travel-time residual measured in seconds. The residual is found by taking the observed arrival time (saved in the **arrival** table) of a seismic phase and subtracting the expected arrival time. The expected arrival time is calculated by a formula based on an earth velocity model (column *vmodel*), an event location and origin time (saved in **origin** table, and the particular seismic phase (column *phase* in **assoc** table).

Format: float(24) External: f8.3

NA Value: -999.0

Units: seconds

Range: *timeres* > -999.0

Name: *tshift*

Table: **sensor**

Description: Correction for clock errors; designed to accommodate discrepancies between the actual time and numerical time written by data recording systems. Actual time is the sum of the reported time plus *tshift*.

Format: float(24) External: f16.2

NA Value: NOT ALLOWED

Units: seconds

Range: any floating point value

Name: *uncertainty*

Table: **netmag, stamag**

Description: Magnitude uncertainty. This value is the standard deviation of the accompanying magnitude measurement.

Format: float(24) External: f7.2

NA Value: -1.0

Range: *uncertainty* > 0.0

Name: *vang*

Table: **sitechan**

Description: Vertical orientation of seismometer. This column measures the angle between the sensitive axis of a seismometer and the outward-pointing vertical direction.
For a vertically oriented seismometer, *vang* = 0
For a horizontally oriented seismometer, *vang* = 90 (see *hang*)

Format: float(24) External: f6.1

NA Value: NOT ALLOWED

Units: degrees

Range: 0.0 ≤ *hang* ≤ 90.0

Name:	*vmodel*	
Table:	**assoc**	
Description:	Velocity model. This character string identifies the velocity model of the Earth used to compute the travel times of seismic phases. A velocity model is required for event location (if phase is defining) or for computing travel-time residuals.	
Format:	varchar2(15)	External: a15
NA Value:	- (hyphen)	
Range:	any character string up to the column size	

Name:	*wfid*	
Table:	**wfdisc, wftag**	
Description:	Unique waveform identifier for a **wfdisc** record.	
Format:	number(9)	External: i9
NA Value:	NOT ALLOWED	
Range:	*wfid* > 0	

Name:	*wgt*	
Table:	**assoc**	
Description:	Location weight. This column gives the final weight assigned to the allied arrival by the location program. This column is used primarily for location programs that adaptively weight data by their residuals.	
Format:	float(24)	External: f6.3
NA Value:	-1.0	
Range:	0.0 < *wgt*	

5.0 References

Anderson, J., W. E. Farrell, K. Garcia, J. Given, H. Swanger, 1990, **Center for Seismic Studies Version 3 Database Schema Reference Manual**, Technical Report C90-01, SAIC-90/1235, 64pp, Science Applications International Corporation, San Diego, California.

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