Technical Report C90-01
September 1990

CENTER FOR SEISMIC STUDIES VERSION 3 DATABASE: SCHEMA REFERENCE MANUAL

J. Anderson, W. E. Farrell, K. Garcia, J. Given, H. Swanger

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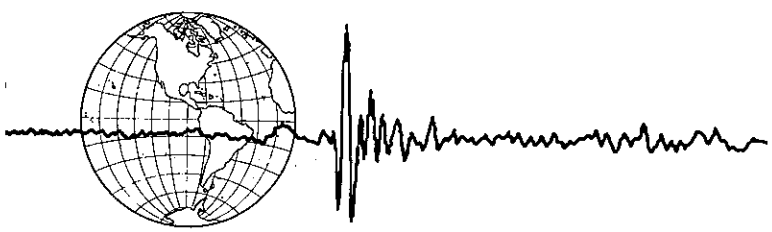

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27 November 1990

Dear Colleague;

Enclosed are copies of two documents important to present and future users of the databases at Center for Seismic Studies. These are:

Center for Seismic Studies Version 3 Database:
Schema Reference Manual
by J. Anderson, W.E. Farrell, K. Garcia, J. Given, H. Swanger

Center for Seismic Studies Version 3 Database:
SQL Tutorial
by J. Anderson, H. Swanger

The **Schema Reference Manual** provides a detailed description of the new format (Version 3.0) for storing seismic parameter data in the Oracle database accounts at the Center. This format has already been adopted by many in the DARPA community to store data both in database management systems and in ASCII files on disk.

The **SQL Tutorial** introduces a powerful language (*SQL* or *Structured Query Language*) for accessing data in a relational database. The **Tutorial** outlines all of the most common SQL commands, then walks the reader through the use of those commands within a Center Version 3.0 seismic database. It may be used at the Center by logging into any of the Sun 4 computers (we suggest the computers *maui* or *sol*), typing:

~oracle/bin/sqlplus geodemo/geodemo@t:hugo:oracle

to access the tutorial database on *hugo* (please do not login to *hugo*), then following the examples in the **Tutorial**.

We hope you will find both documents useful and will distribute copies of them to others at your site who might have need of them. Note too that a *User's Guide to the Center for Seismic Studies* will be available in early in 1991 and will describe the hardware, software, and data resources available at the Center. Please do not hesitate to forward to me any questions about these documents, Center resources, or obtaining an account at the Center.

Best Regards,

Steven R. Bratt
Director, Geophysical Systems and Support
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J. Anderson, W.E. Farrell, K. Garcia, J. Given, H. Swanger

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Sponsored by:
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Nuclear Monitoring Research Office
ARPA Order Number 6266-1, 5 & 7
Issued by:
DARPA/CMO
Under Contract No. MDA972-88-C-0024

Science Applications International Corp.
Center for Seismic Studies
1300 N. 17th Street, #1450
Arlington, VA 22209-3871

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) SAIC-90/1235 CSS Technical Report C90-01	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Science Applications Int'l. Corp 6b. OFFICE SYMBOL (If applicable)	7a. NAME OF MONITORING ORGANIZATION Defense Advanced Research Projects Agency (DARPA)
6c. ADDRESS (City, State, and ZIP Code) 10260 Campus Pt. Drive San Diego, CA 92121	7b. ADDRESS (City, State, and ZIP Code) 1400 Wilson Blvd. Arlington, VA 22209
8a. NAME OF FUNDING / SPONSORING ORGANIZATION DARPA 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA972-88-C-0024
8c. ADDRESS (City, State, and ZIP Code) 1400 Wilson Blvd. Arlington, VA 22209	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. 0602111E; PROJECT NO. NM-01; TASK NO. NA; WORK UNIT ACCESSION NO. NA

11. TITLE (Include Security Classification)
Center for Seismic Studies Version 3 Database: Schema Reference Manual

12. PERSONAL AUTHOR(S)
J. Anderson, W. Farrell, K. Garcia, J. Given, H. Swanger

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Quarterly Technical	FROM 5/15/89 TO 8/16/89	June 1990	64

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Seismology, Nuclear Test Detection, Database Management Systems

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This is the second quarterly *Technical Report* under this contract, covering the period from 16 May 1989 to 15 August 1989. It includes a detailed description of a new version (Version 3.0) of the database structure for the Center for Seismic Studies. The report briefly describes the evolution of the Version 3.0 structure and the philosophy used to design the database. It includes three appendices with tables defining the structure of the relations, a glossary describing each relation, and a glossary describing the attributes.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Major Bruce Varnum	22b. TELEPHONE (Include Area Code) (202) 694-3622 22c. OFFICE SYMBOL

Table of Contents

1.0 INTRODUCTION

This volume describes the schema of the Version 3.0 database. It is the new standard for data and software at the Center for Seismic Studies. The evolution of Version 3.0 and the philosophy motivating its design are briefly described in this first chapter, but the major objective of this volume is satisfied by the detailed descriptions of the Version 3.0 database structure, relations, and attributes which appear in chapters 2, 3 and 4.

1.1. HISTORICAL BACKGROUND

Application of relational database technology by the seismic monitoring community is now almost a decade old.[1] The initial work was done by Lawrence Berkeley Laboratory and the Discrimination Group at Lincoln Laboratories in the early 1980's. This work was continued by S-Cubed staff working at the Center for Seismic Studies in 1982-83, culminating with the release of Version 2.6[2] which was in general use at the Center for Seismic Studies by late-1983. Version 2.7, released in 1984, made some additions and changes to accommodate the needs of the 1984 GSE Technical Test.

When these early versions were designed, the emphasis was primarily on teleseismic events and most of the data were acquired and stored on tapes. Researchers did not interact directly with the database, but used standard utilities which copied the data of interest from the database into flat files. As far as software development was concerned, the major effect of the database structure was to standardize formats for data used by a wide variety of programs.

Version 2.8[3] was designed in 1987 to meet the needs of the Intelligent Array System (*IAS*). The *IAS* was a significant departure from previous systems in that it processed near real-time data automatically and used the database directly, accessing data with embedded SQL. The *IAS* performance requirements (particularly for interactive analysis) introduced some important new design considerations, and *IAS* operation in 1989 provided valuable practical experience with the issues involved.

The NMRD project began in 1989 with a comprehensive modernization of the Center database management system as an important objective. A new database structure was required to take advantage of past experience to support all classes of users (ranging from automated and interactive processing of near real-time data to database construction for off-line research projects). The new structure was also motivated by the need to handle regional and teleseismic data equally well. The initial version of the new structure was called Version 2.9. However, as the design matured, it became clear that this was a major upgrade that is more properly called Version 3.0

Some of the most important limitations of earlier versions that are addressed by Version 3.0 include:

- A simpler structure was needed to facilitate use by the scientific research community. Evolution over time had resulted in complex data structures not supported by the current ANSI SQL standard. This complicates access (particularly for interactive users) and maintenance.

- The most recent structure (Version 2.8) retained most of the relations used for teleseismic data and added new relations tailored specifically for arrays and *IAS* processing. Thus, there is significant duplication of information in different relations, and no convenient structures for supporting more general processing. Also, important features of three-component data are neglected.

- Earlier versions could not manage properly the temporally varying changes in instrument calibration.

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[1] For a review of the considerations motivating the original design, see "A Seismological Data Base Management System" by J. Berger, R.G. North, R.C. Goff, and M.A. Tiberio in *BSSA*, Vol. 74, pp. 1849-1862.

[2] J. Berger, R.C. Goff, R.G. North, W.E. Farrell, M.A. Tiberio, B. Shkoller, *Center for Seismic Studies: Prototype Design and Development*, S-Cubed Final Report, Task IV, Volume I, 1983.

[3] M.A. Brennan, *Center for Seismic Studies Database Structure Version 2.8*, Center for Seismic Studies Technical Report C87-04, September, 1987

In summary, Version 3.0 is designed to provide a database structure which facilitates the wide range of applications supported at the Center for Seismic Studies, including real-time and interactive processing, maintenance of a historical data archive, and support for seismological research. The objective is not to provide specific structures that support all applications, but to provide a framework that all applications can share.

1.2. DESCRIPTION OF VERSION 3.0

1.2.1. Design Philosophy

The major principles followed in the design of Version 3.0 are as follows:

Separate core tables which are of general interest from application-specific tables which store application-specific and/or intermediate results.

- Design the core relations to encourage interactive and embedded SQL access by the scientific community; that is, make them readable and compatible with seismological conventions.
- Complex data structures and relationships are to be limited to application-specific tables.

1.2.2. Basic Structure of Version 3.0

There are 21 relations in the core set in Version 3.0. These are separated into "Primary" and "Lookup" relations. The 11 Primary relations are dynamic and contain attributes used in automated and interactive processing (e.g., seismic arrivals, event locations). The 10 Lookup tables change infrequently and are used for auxiliary information used by the processing (e.g., station locations). In general terms, the information stored in the core relations includes:

- arrivals (seismic signals)
- events, origins, association of arrivals
- magnitude information
- station information (networks, site descriptions, instrument responses)
- pointers to disk and tape files storing waveform data
- attributes describing the contents of the dynamic relations
- administrative data (counters, seismic and geographic regions)

1.2.3. User Support for Version 3.0

There is a library of software available at the Center for Seismic Studies, which simplifies use of the Version 3.0 database. This library is written with embedded SQL and includes functions to accomplish:

- database opens/closes
- transaction management control
- error handling routines
- key counter assignment
- insert routines for all core tables

This library is intended to limit the duplicate development of database access routines by many users. The library may be used by either C or FORTRAN applications. It is not intended to be an exhaustive interface to the database, and each application area will need to develop its own application-specific libraries.

There is much existing software which does not use embedded SQL, but obtains data from external files containing data extracted from the database with the *cpout* utility. This utility is being modified to output flat file records in either the Version 2.7 or 3.0 format. The need for files in Version 2.7 format should disappear over time as users convert to embedded SQL or Version 3.0 flat files.

The remainder of this volume consists of three Chapters:

Chapter 2 *Database Structure*
Each relation is defined, including both internal and external formats of the attributes for C and FORTRAN programs.

Chapter 3 *Database Relations*
The logical design of the database is expressed in Entity-Relationship diagrams and each relation is described to identify the key fields and the links among the relations.

Chapter 4 *Database Attributes*
Each attribute is described.

In each chapter database relations are always printed boldface, and database attributes are always printed italicized.

The documentation describing the structure of the Version 3.0 Database consists of several volumes. One companion volume, the *SQL Tutorial*, is also in print. Two more volumes, one describing the technical basis for the schema, another a user's guide to data at the Center for Seismic Studies, are in preparation.

1.3. ACKNOWLEDGEMENTS

The Version 3 database schema is the latest in a sequence that goes back nearly a decade. A brief revision history is given in Chapter 9 of Brennan's report (1987, op cit). Numerous people have made substantial contributions to this continuing effort, although the fundamental arrangement of attributes among relations still shows strongly the influence of the earliest Lincoln Laboratory work. As with earlier versions, Mary Ann Brennan and Steve Bratt made substantial contributions, as did Richard Stead.

2.0 DATABASE STRUCTURE

This chapter defines the physical structure of each table, as it exists within the ORACLE data dictionary and as it can exist as a flat file. The name of the relation appears in **bold** print at the top. Key attributes are shown first, convenience attributes next, followed by data fields. This hierarchy is described in the introduction to Chapter 3. Formats for "external" files specify fixed field widths and precisions in the style of FORTRAN. Exactly one blank separates fields in these files. This improves readability and makes it easier for C programs to scan the records. All numeric entries are right justified and all character strings are left justified. Having the field number quickly accessible is useful when dealing with flat files (e.g. *awk* and shell scripts).

Relation:	**affiliation**				
Description:	Network station affiliations				
attribute name	field no.	storage type	external format	character positions	attribute description
net	1	c8	a8	1-8	unique network identifier
sta	2	c6	a6	10-15	station identifier
lddate	3	date	a17	17-33	load date

Relation:	**arrival**				
Description:	Summary information on a seismic arrival				
attribute name	field no.	storage type	external format	character positions	attribute description
sta	1	c6	a6	1-6	station code
time	2	f8	f17.5	8-24	epoch time
arid	3	i4	i8	26-33	arrival id
jdate	4	i4	i8	35-42	julian date
stassid	5	i4	i8	44-51	stassoc id
chanid	6	i4	i8	53-60	instrument id
chan	7	c8	a8	62-69	channel code
iphase	8	c8	a8	71-78	reported phase
stype	9	c1	a1	80-80	signal type
deltim	10	f4	f6.3	82-87	delta time
azimuth	11	f4	f7.2	89-95	observed azimuth
delaz	12	f4	f7.2	97-103	delta azimuth
slow	13	f4	f7.2	105-111	observed slowness (s/deg)
delslo	14	f4	f7.2	113-119	delta slowness
ema	15	f4	f7.2	121-127	emergence angle
rect	16	f4	f7.3	129-135	rectilinearity
amp	17	f4	f10.1	137-146	amplitude, instrument corrected, nm
per	18	f4	f7.2	148-154	period
logat	19	f4	f7.2	156-162	log(amp/per)
clip	20	c1	a1	164-164	clipped flag
fm	21	c2	a2	166-167	first motion
snr	22	f4	f10.2	169-178	signal to noise ratio
qual	23	c1	a1	180-180	signal onset quality
auth	24	c15	a15	182-196	source/originator
commid	25	i4	i8	198-205	comment id
lddate	26	date	a17	207-223	load date

Relation:	**assoc**				
Description:	Data associating arrivals with origins				
attribute name	field no.	storage type	external format	character positions	attribute description
arid	1	i4	i8	1-8	arrival id
orid	2	i4	i8	10-17	origin id
sta	3	c6	a6	19-24	station code
phase	4	c8	a8	26-33	associated phase
belief	5	f4	f4.2	35-38	phase confidence
delta	6	f4	f8.3	40-47	station to event distance
seaz	7	f4	f7.2	49-55	station to event azimuth
esaz	8	f4	f7.2	57-63	event to station azimuth
timeres	9	f4	f8.3	65-72	time residual
timedef	10	c1	a1	74-74	time = defining, non-defining
azres	11	f4	f7.1	76-82	azimuth residual
azdef	12	c1	a1	84-84	azimuth = defining, non-defining
slores	13	f4	f7.2	86-92	slowness residual
slodef	14	c1	a1	94-94	slowness = defining, non-defining
emares	15	f4	f7.1	96-102	incidence angle residual
wgt	16	f4	f6.3	104-109	location weight
vmodel	17	c15	a15	111-125	velocity model
commid	18	i4	i8	127-134	comment id
lddate	19	date	a17	136-152	load date

Relation:	**event**				
Description:	Event identification				
attribute name	field no.	storage type	external format	character positions	attribute description
evid	1	i4	i8	1-8	event id
evname	2	c15	a15	10-24	event name
prefor	3	i4	i8	26-33	preferred origin
auth	4	c15	a15	35-49	source/originator
commid	5	i4	i8	51-58	comment id
lddate	6	date	a17	60-76	load date

Relation:	**gregion**				
Description:	Geographic region				
attribute name	field no.	storage type	external format	character positions	attribute description
grn	1	i4	i8	1-8	geographic region number
grname	2	c40	a40	10-49	geographic region name
lddate	3	date	a17	51-67	load date

Relation:	**instrument**				
Description:	Generic (default) calibration information about a station				
attribute name	field no.	storage type	external format	character positions	attribute description
inid	1	i4	i8	1-8	instrument id
insname	2	c50	a50	10-59	instrument name
instype	3	c6	a6	61-66	instrument type
band	4	c1	a1	68-68	frequency band
digital	5	c1	a1	70-70	(d,a) analog
samprate	6	f4	f11.7	72-82	sampling rate in samples/second
ncalib	7	f4	f16.6	84-99	nominal calibration
ncalper	8	f4	f16.6	101-116	nominal calibration period
dir	9	c64	a64	118-181	directory
dfile	10	c32	a32	183-214	data file
rsptype	11	c6	a6	216-221	response type
lddate	12	date	a17	223-239	load date

Relation:	**lastid**				
Description:	Counter values (Last value used for keys)				
attribute name	field no.	storage type	external format	character positions	attribute description
keyname	1	c15	a15	1-15	id name (arid, orid, etc.)
keyvalue	2	i4	i8	17-24	last value used for that id
lddate	3	date	a17	26-42	load date

Relation:	**netmag**				
Description:	Network magnitude				
attribute name	field no.	storage type	external format	character positions	attribute description
magid	1	i4	i8	1-8	network magnitude identifier
net	2	c8	a8	10-17	unique network identifier
orid	3	i4	i8	19-26	origin id
evid	4	i4	i8	28-35	event id
magtype	5	c6	a6	37-42	magnitude type (ml, ms, mb, etc.)
nsta	6	i4	i8	44-51	number of stations used
magnitude	7	f4	f7.2	53-59	magnitude
uncertainty	8	f4	f7.2	61-67	magnitude uncertainty
auth	9	c15	a15	69-83	source/originator
commid	10	i4	i8	85-92	comment id
lddate	11	date	a17	94-110	load date

Relation:	**origin**			
Description:	Data on event location and confidence bounds			
attribute name	field no.	storage type	external format	character positions	attribute description
lat	1	f4	f9.4	1-9	estimated latitude
lon	2	f4	f9.4	11-19	estimated longitude
depth	3	f4	f9.4	21-29	estimated depth
time	4	f8	f17.5	31-47	epoch time
orid	5	i4	i8	49-56	origin id
evid	6	i4	i8	58-65	event id
jdate	7	i4	i8	67-74	julian date
nass	8	i4	i4	76-79	number of associated phases
ndef	9	i4	i4	81-84	number of locating phases
ndp	10	i4	i4	86-89	number of depth phases
grn	11	i4	i8	91-98	geographic region number
srn	12	i4	i8	100-107	seismic region number
etype	13	c7	a7	109-115	event type
depdp	14	f4	f9.4	117-125	estimated depth from depth phases
dtype	15	c1	a1	127-127	depth method used
mb	16	f4	f7.2	129-135	body wave magnitude
mbid	17	i4	i8	137-144	mb magid
ms	18	f4	f7.2	146-152	surface wave magnitude
msid	19	i4	i8	154-161	ms magid
ml	20	f4	f7.2	163-169	local magnitude
mlid	21	i4	i8	171-178	ml magid
algorithm	22	c15	a15	180-194	location algorithm used
auth	23	c15	a15	196-210	source/originator
commid	24	i4	i8	212-219	comment id
lddate	25	date	a17	221-237	load date

Relation:	**remark**				
Description:	Comments				
attribute name	field no.	storage type	external format	character positions	attribute description
commid	1	i4	i8	1-8	comment id
lineno	2	i4	i8	10-17	comment line number
remark	3	c80	a80	19-98	free format comment
lddate	4	date	a17	100-116	load date

Relation:	**network**			
Description:	Network description and identification			
attribute name	field no.	storage type	external format	character positions	attribute description
net	1	c8	a8	1-8	unique network identifier
netname	2	c80	a80	10-89	network name
nettype	3	c4	a4	91-94	network type, array, local, world-wide, etc.
auth	4	c15	a15	96-110	source/originator
commid	5	i4	i8	112-119	comment id
lddate	6	date	a17	121-137	load date

Relation:	**origerr**			
Description:	Summary of errors in origin estimations			
attribute name	field no.	storage type	external format	character positions	attribute description
orid	1	i4	i8	1-8	origin id
sxx	2	f4	f15.4	10-24	covariance matrix element
syy	3	f4	f15.4	26-40	covariance matrix element
szz	4	f4	f15.4	42-56	covariance matrix element
stt	5	f4	f15.4	58-72	covariance matrix element
sxy	6	f4	f15.4	74-88	covariance matrix element
sxz	7	f4	f15.4	90-104	covariance matrix element
syz	8	f4	f15.4	106-120	covariance matrix element
stx	9	f4	f15.4	122-136	covariance matrix element
sty	10	f4	f15.4	138-152	covariance matrix element
stz	11	f4	f15.4	154-168	covariance matrix element
sdobs	12	f4	f9.4	170-178	std err of obs
smajax	13	f4	f9.4	180-188	semi-major axis of error
sminax	14	f4	f9.4	190-198	semi-minor axis of error
strike	15	f4	f6.2	200-205	strike of the semi-major axis
sdepth	16	f4	f9.4	207-215	depth error
stime	17	f4	f8.2	217-224	origin time error
conf	18	f4	f5.3	226-230	confidence
commid	19	i4	i8	232-239	comment id
lddate	20	date	a17	241-257	load date

Relation: **sensor**
Description: Specific calibration information for physical channels

attribute name	field no.	storage type	external format	character positions	attribute description
sta	1	c6	a6	1-6	station code
chan	2	c8	a8	8-15	channel code
time	3	f8	f17.5	17-33	epoch time of start of recording period
endtime	4	f8	f17.5	35-51	epoch time of end of recording period
inid	5	i4	i8	53-60	instrument id
chanid	6	i4	i8	62-69	channel id
jdate	7	i4	i8	71-78	julian date
calratio	8	f4	f16.6	80-95	calibration
calper	9	f4	f16.6	97-112	calibration period
tshift	10	f4	f6.2	114-119	correction of data processing time
instant	11	c1	a1	121-121	(y,n) discrete/continuing snapshot
lddate	12	date	a17	123-139	load date

Relation: **site**
Description: Station location information

attribute name	field no.	storage type	external format	character positions	attribute description
sta	1	c6	a6	1-6	station identifier
ondate	2	i4	i8	8-15	Julian start date
offdate	3	i4	i8	17-24	Julian off date
lat	4	f4	f9.4	26-34	latitude
lon	5	f4	f9.4	36-44	longitude
elev	6	f4	f9.4	46-54	elevation
staname	7	c50	a50	56-105	station description
statype	8	c4	a4	107-110	station type: single station, virt. array, etc.
refsta	9	c6	a6	112-117	reference station for array members
dnorth	10	f4	f9.4	119-127	offset from array reference (km)
deast	11	f4	f9.4	129-137	offset from array reference (km)
lddate	12	date	a17	139-155	load date

Relation: **sitechan**
Description: Station-channel information

attribute name	field no.	storage type	external format	character positions	attribute description
sta	1	c6	a6	1-6	station identifier
chan	2	c8	a8	8-15	channel identifier
ondate	3	i4	i8	17-24	Julian start date
chanid	4	i4	i8	26-33	channel id
offdate	5	i4	i8	35-42	Julian off date
ctype	6	c4	a4	44-47	channel type
edepth	7	f4	f9.4	49-57	emplacement depth
hang	8	f4	f6.1	59-64	horizontal angle
vang	9	f4	f6.1	66-71	vertical angle
descrip	10	c50	a50	73-122	channel description
lddate	11	date	a17	124-140	load date

Relation:	**sregion**			
Description:	Seismic region			
attribute name	field no.	storage type	external format	character positions	attribute description
srn	1	i4	i8	1-8	seismic region number
srname	2	c40	a40	10-49	seismic region name
lddate	3	date	a17	51-67	load date

Relation:	**stamag**			
Description:	Station magnitude			
attribute name	field no.	storage type	external format	character positions	attribute description
magid	1	i4	i8	1-8	magnitude id
sta	2	c6	a6	10-15	station code
arid	3	i4	i8	17-24	arrival id
orid	4	i4	i8	26-33	origin id
evid	5	i4	i8	35-42	event id
phase	6	c8	a8	44-51	associated phase
magtype	7	c6	a6	53-58	magnitude type (ml, ms, mb, etc.)
magnitude	8	f4	f7.2	60-66	magnitude
uncertainty	9	f4	f7.2	68-74	magnitude uncertainty
auth	10	c15	a15	76-90	source/originator
commid	11	i4	i8	92-99	comment id
lddate	12	date	a17	101-117	load date

Relation:	**stassoc**			
Description:	Arrivals from a single station grouped into an event			
attribute name	field no.	storage type	external format	character positions	attribute description
stassid	1	i4	i8	1-8	stassoc id
sta	2	c6	a6	10-15	station code
etype	3	c7	a7	17-23	event type
location	4	c32	a32	25-56	apparent location description
dist	5	f4	f7.2	58-64	estimated distance
azimuth	6	f4	f7.2	66-72	observed azimuth
lat	7	f4	f9.4	74-82	estimated latitude
lon	8	f4	f9.4	84-92	estimated longitude
depth	9	f4	f9.4	94-102	estimated depth
time	10	f8	f17.5	104-120	estimated origin time
imb	11	f4	f7.2	122-128	initial estimated mb
ims	12	f4	f7.2	130-136	initial estimated ms
iml	13	f4	f7.2	138-144	initial estimated ml
auth	14	c15	a15	146-160	source/originator
commid	15	i4	i8	162-169	comment id
lddate	16	date	a17	171-187	load date

Relation:	**wfdisc**				
Description:	Waveform file header and descriptive information				
attribute name	field no.	storage type	external format	character positions	attribute description
sta	1	c6	a6	1-6	station
chan	2	c8	a8	8-15	channel
time	3	f8	f17.5	17-33	epoch time of first sample in file
wfid	4	i4	i8	35-42	waveform id
chanid	5	i4	i8	44-51	channel operation id
jdate	6	i4	i8	53-60	julian date
endtime	7	f8	f17.5	62-78	time+(nsamp-1)/samprate
nsamp	8	i4	i8	80-87	number of samples
samprate	9	f4	f11.7	89-99	sampling rate in samples/sec
calib	10	f4	f16.6	101-116	nominal calibration
calper	11	f4	f16.6	118-133	nominal calibration period
instype	12	c6	a6	135-140	instrument code
segtype	13	c1	a1	142-142	indexing method
datatype	14	c2	a2	144-145	numeric storage
clip	15	c1	a1	147-147	clipped flag
dir	16	c64	a64	149-212	directory
dfile	17	c32	a32	214-245	data file
foff	18	i4	i10	247-256	byte offset
commid	19	i4	i8	258-265	comment id
lddate	20	date	a17	267-283	load date

Relation:	**wftag**				
Description:	Waveform mapping file				
attribute name	field no.	storage type	external format	character positions	attribute description
tagname	1	c8	a8	1-8	key (arid, orid, evid, etc.)
tagid	2	i4	i8	10-17	tagname value
wfid	3	i4	i8	19-26	waveform id
lddate	4	date	a17	28-44	load date

Relation:	**wftape**				
Description:	Waveform tape file header and descriptive information				
attribute name	field no.	storage type	external format	character positions	attribute description
sta	1	c6	a6	1-6	station
chan	2	c8	a8	8-15	channel
time	3	f8	f17.5	17-33	epoch time of first sample in file
wfid	4	i4	i8	35-42	waveform id
chanid	5	i4	i8	44-51	channel operation id
jdate	6	i4	i8	53-60	julian date
endtime	7	f8	f17.5	62-78	time+(nsamp-1)/samprate
nsamp	8	i4	i8	80-87	number of samples
samprate	9	f4	f11.7	89-99	sampling rate in samples/sec
calib	10	f4	f16.6	101-116	nominal calibration
calper	11	f4	f16.6	118-133	nominal calibration period
instype	12	c6	a6	135-140	instrument code
segtype	13	c1	a1	142-142	indexing method
datatype	14	c2	a2	144-145	numeric storage
clip	15	c1	a1	147-147	clipped flag
dir	16	c64	a64	149-212	directory
dfile	17	c32	a32	214-245	data file
volname	18	c6	a6	247-252	tape name
tapefile	19	i4	i5	254-258	tape file number
tapeblock	20	i4	i5	260-264	block number in tape file
commid	21	i4	i8	266-273	comment id
lddate	22	date	a17	275-291	load date

3.0 DATABASE RELATIONS

This chapter describes the ORACLE relations that comprise the Version 3.0 Schema. The information given here, along with that in Chapter 4, *Database Attributes*, constitutes the data dictionary. There is an entry for each relation. Within the entry, the relation's name appears first, followed by a list of its attributes. A brief description completes the entry. The attributes of the relation are arranged in the following order: Keys, Convenience, Data. Key attributes link relations. Convenience attributes are redundant data whose real home is another relation, but are included in this table for the sake of convenience. Data attributes, the reason this table exists, are split into three categories: Descriptive, Measurement and Administrative. The following tableau explains the format used in the entries.

Name:	This is the name of the relation.	
Keys:	Primary.	These are the attributes which, taken together, uniquely identify a row in the table.
	Alternate.	These are other attributes which also uniquely identify a row and may be used as primary keys.
	Foreign.	These attributes are primary keys in another table.
Convenience:	Attributes in this class, if any, are data-attributes in another table.	
Data:	Descriptive.	Qualitative attributes are listed under this heading.
	Measurement.	This class contains a list of quantitative attributes.
	Administrative.	This class lists attributes used for database administration.
Description:	This paragraph describes the relation.	

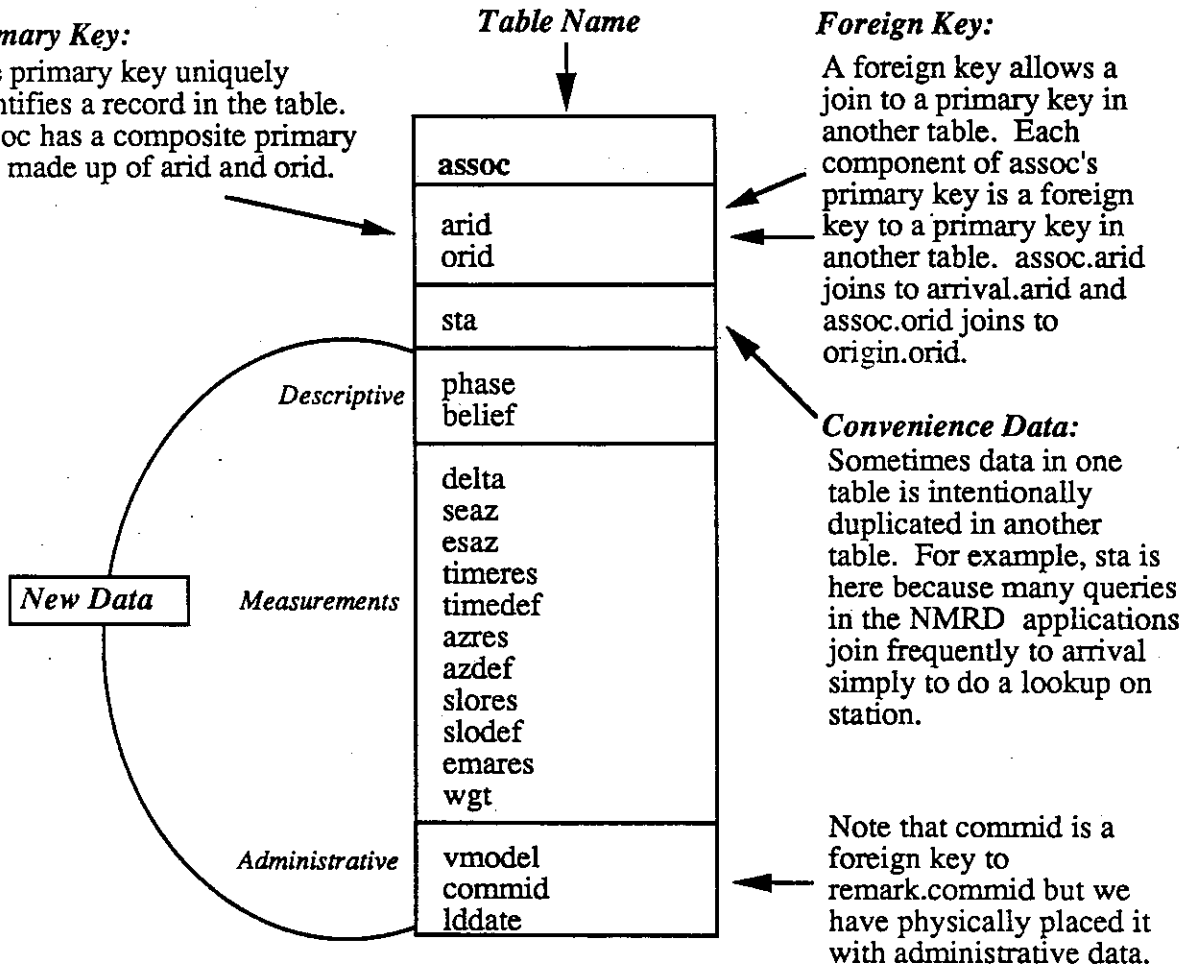
Keys provide the links by which tables are joined. The following definitions explain the several types of keys.

> A primary key (which often is the concatenation of several attributes) uniquely identifies a row in the table. For example, each **origin** record is unique by *lat, lon, depth*, and *time*.
>
> An alternate key also uniquely identifies a row in the table and may be used as the primary key. For example, *orid* may also be used as the primary key for the **origin** table.
>
> A foreign key is another table's primary key. Thus, *evid* is a foreign key in the **origin** table, but is the primary key in the **event** table. Similarly, *commid* is a foreign key in many of the tables and the primary key in **remark**.

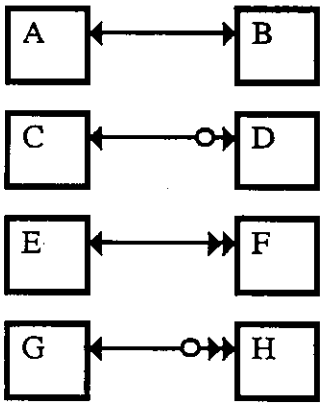
Entity-relationship (E-R) diagrams are a powerful way of describing a database schema. In this methodology, a rectangle is drawn to represent a table, its attributes are shown inside, and lines between the rectangles show how the tables are joined. The E-R model of the Version 3.0 schema is shown in Figures 3.1, 3.2, and 3.3. Figure 3.1 shows the terminology and the iconology used in the two succeeding figures. Note particularly the bottom half of Figure 3.1 which shows the symbols employed to depict the kinds of relationships that can exist between tables.

The entire schema is modeled in Figures 3.2 and 3.3, except that only key attributes for each table are shown. The full listing of attributes, and a formal definition of the structures was previously given in Chapter 2, *Database Structure*. Chapter 4, *Database Attributes*, gives a detailed description of each attribute. One key attribute, *chanid*, is left out entirely, since it appears in the schema only as a foreign key, never a primary key.

Anatomy of an NMRD Table



Relationships Between Tables



For one A, there is one B

For one C, there is zero or one D's

For one E, there is one or many F's

For one G, there is zero, one, or many H's

Figure 3.1

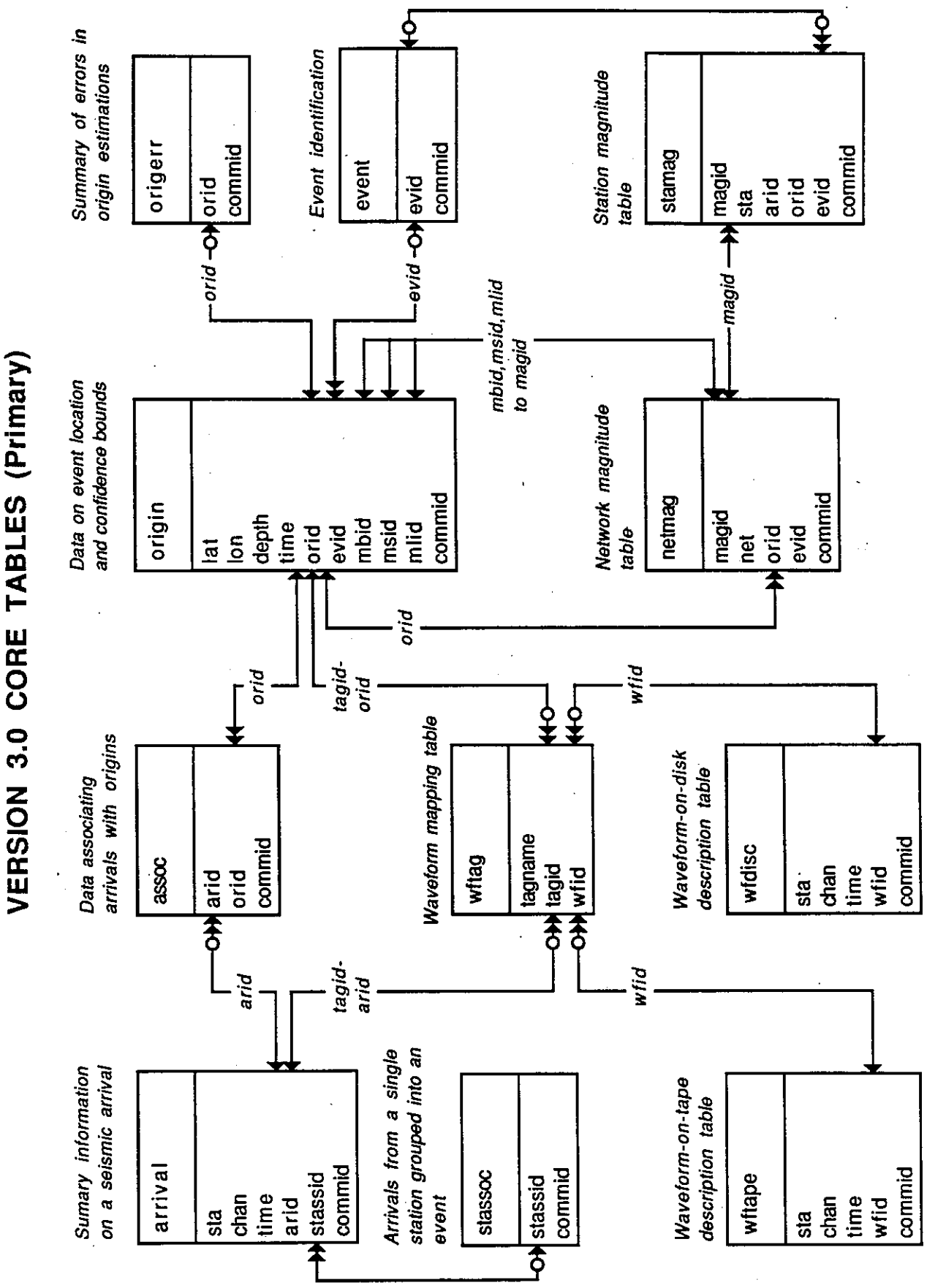


Figure 3.2

Note: only primary and foreign keys are shown

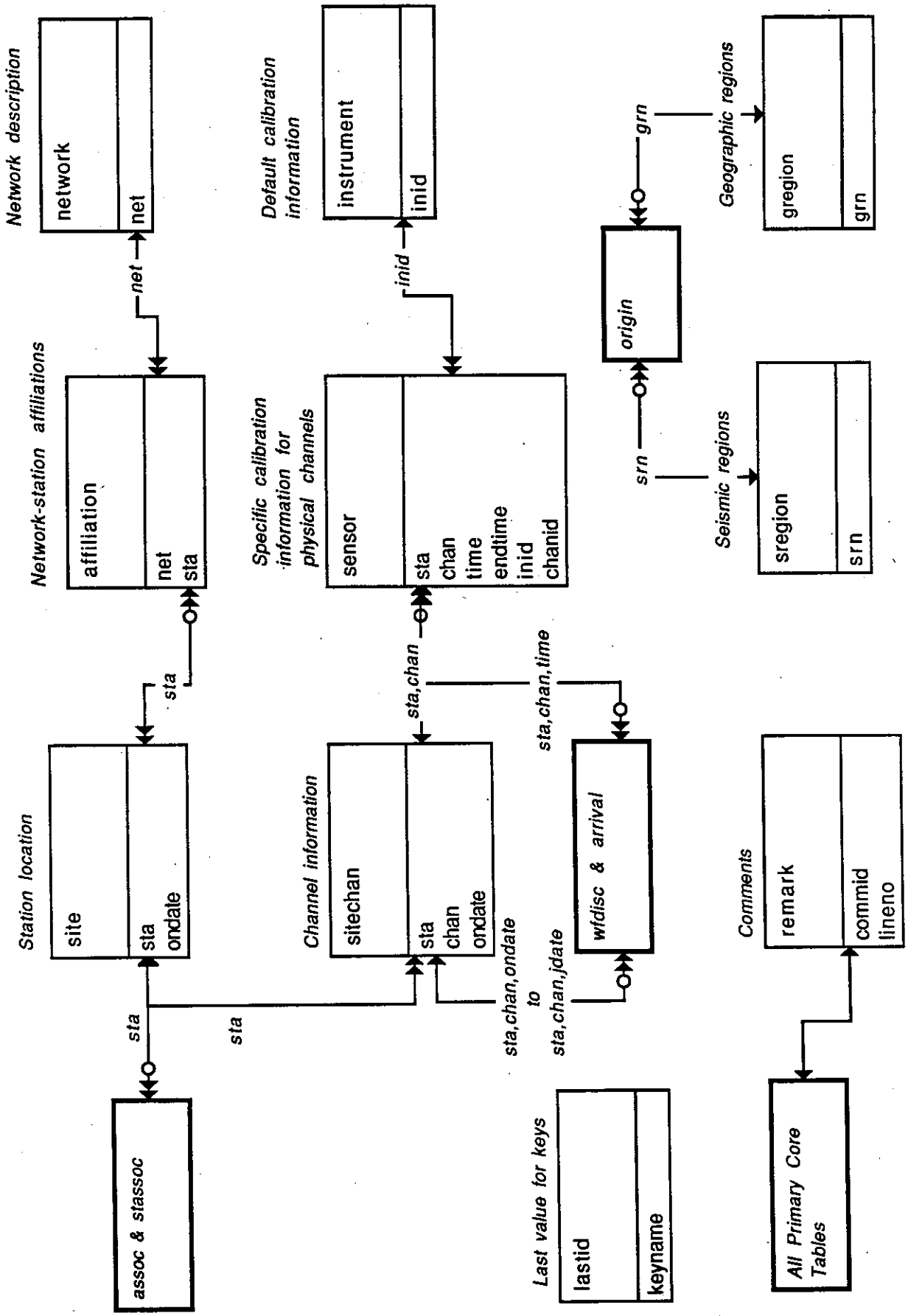


Figure 3.3 *Note: only primary and foreign keys are shown*

Name:	**affiliation**	
Keys:	Primary.	*net, sta*
Data:	Administrative.	*lddate*
Description:	Network-Station affiliations. This is an intermediate relation by which seismic stations may be clustered into networks.	

Name:	**arrival**	
Keys:	Primary.	*sta, time*
	Alternate.	*arid*
	Foreign.	*stassid, chanid, commid*
Convenience:	*jdate*	
Data:	Descriptive.	*chan, iphase, stype*
	Measurement.	*deltim, azimuth, delaz, slow, delslo, ema, rect, amp, per, logat, clip, fm, qual*
	Administrative.	*auth, lddate*
Description:	Summary information on a seismic arrival. Information characterizing a "seismic phase" observed at a particular station is saved here. Many of the attributes conform to seismological convention and are listed in earthquake catalogs.	

Name:	**assoc**	
Keys:	Primary.	*arid, orid*
	Foreign.	*commid*
Convenience:	*sta*	
Data:	Descriptive.	*phase, belief*
	Measurement.	*delta, seaz, esaz, timeres, timedef, azres, azdef, slores, slodef, emares, wgt*
	Administrative.	*vmodel, lddate*
Description:	Data associating arrivals with origins. This table has information that connects arrivals (i.e., entries in the **arrival** relation) to a particular origin. It has a composite key made of *arid* and *orid*. There are two kinds of measurement data: three attributes are related to the station (*delta, seaz, esaz*), and the remaining measurement attributes are jointly determined by the measurements made on the seismic wave (**arrival**), and the inferred event's origin (**origin**). The attribute *sta* is intentionally duplicated in this table to eliminate the need for a join with **arrival** when doing a lookup on station.	

Name:	**event**	
Keys:	Primary.	*evid*
	Foreign.	*commid*
Data:	Descriptive.	*evname, prefor*
	Administrative.	*auth, lddate*
Description:	Event to origin connection. The purpose of this relation is to allow the connection of multiple origins to one *event*. *Prefor* points to the preferred origin.	

Name:	**gregion**	
Keys:	Primary.	*grn*
Data:	Descriptive.	*grname*
	Administrative.	*lddate*
Description:	Geographic regions. This static relation contains geographic region numbers and their equivalent English representation. (See Flinn et al., BSSA, v64, p2, July, 1974.)	

Name:	**instrument**	
Keys:	Primary.	*inid*
Data:	Descriptive.	*insname, instype, band, digital, dir, dfile, rsptype*
	Measurement.	*samprate, ncalib, ncalper*
	Administrative.	*lddate*
Description:	Ancillary calibration information. This table serves three purposes. It holds nominal one-frequency calibration factors for each instrument. It holds pointers to the nominal frequency-dependent calibration for an instrument. Finally, it holds pointers to the exact calibrations obtained by direct measurement on a particular instrument. See **sensor**.	

Name:	**lastid**	
Keys:	Primary.	*keyname*
Data:	Descriptive.	*keyvalue*
	Administrative.	*lddate*
Description:	Counter values (last value used for keys). This relation is a reference table from which programs may retrieve the last sequential value of one of the numeric keys. Unique keys are required before inserting a record in numerous tables. The table has exactly one row for each *keyname*. In the core schema there are just 9 distinct identifier keys: *arid, chanid, commid, evid, inid, magid, orid, stassid, wfid*. This table will also support application-specific keys as needed. Users are encouraged to use the dbgetcounter library routine to obtain a counter value.	

Name: **netmag**

Keys:
- Primary. *magid*
- Foreign. *evid, net, orid, commid*

Data:
- Descriptive. *magtype, nsta*
- Measurement. *magnitude, uncertainty*
- Administrative. *auth, lddate*

Description: Network magnitude. This table summarizes estimates of network magnitudes of different types for an event. Each network magnitude has a unique *magid*. Station magnitudes used to compute the network magnitude are in the relation **stamag**.

Name: **network**

Keys:
- Primary. *net*
- Foreign. *commid*

Data:
- Descriptive. *netname, nettype*
- Administrative. *auth, lddate*

Description: Network description and identification. This relation gives general information about seismic networks. See **affiliation**.

Name: **origerr**

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*

Description: Summary of confidence bounds in origin estimations. The error estimates associated with the parameters in the **origin** relation are saved in this table. The measurement attributes are the elements of the location covariance matrix. The descriptive attributes, which are more meaningful, describe the uncertainities in location, depth and origin time. These quantities are calculated from the covariance matrix, assuming gaussian errors and a confidence level *conf*.

Name: **origin**

Keys:
- Primary. *lat, lon, depth, time*
- Alternate. *orid*
- Foreign. *evid, commid*

Convenience: *jdate*

Data:
- Descriptive. *nass, ndef, ndp, grn, srn, etype*
- Measurement. *depdp, dtype, mb, mbid, ms, msid, ml, mlid*
- Administrative. *algorithm, auth, lddate*

Description: Summary of hypocentral parameters. Information describing a derived or reported origin for a particular event is stored in this table.

Name: **remark**

Keys: Primary. *commid, lineno*

Data: Descriptive. *remark*
Administrative. *lddate*

Description: Comments. This relation may be used to store free-form comments that embellish records of other relations. The *commid* field in many relations refers to a tuple in the **remark** table. If *commid* is null (-1) in a tuple of any other relation, there are no comments stored for that tuple.

Name: **sensor**

Keys: Primary. *sta, chan, time, endtime*
Foreign. *inid*

Convenience: *chanid, jdate*

Data: Descriptive. *instant*
Measurement. *calratio, calper, tshift*
Administrative. *lddate*

Description: 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 relation **instrument**.
Waveform data are converted into physical units through multiplication by the *calib* attribute located in **wfdisc**. It can happen that the correct value of *calib* is not accurately known when the **wfdisc** record is entered into the data base. The **sensor** relation provides the mechanism (*calratio* and *calper*) to "update" *calib*, without requiring that possibly hundreds of **wfdisc** records be updated.
Through the foreign key *inid* this table is linked to **instrument** which has fields pointing to flat files holding detailed calibration information in a variety of formats. See **instrument**.

Name: **site**

Keys: Primary. *sta, ondate*

Data: Descriptive. *staname, statype, refsta*
Measurement. *offdate, lat, lon, elev, dnorth, deast*
Administrative. *lddate*

Description: Station location information. **Site** names and describes a point on the earth where seismic measurements are made (e.g. the location of a seismic instrument or array). It contains information that normally changes infrequently, such as location. In addition, **site** contains fields to 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 **sitechan**.

Name:	**sitechan**	
Keys:	Primary.	*sta, chan, ondate*
	Alternate.	*chanid*
Data:	Descriptive.	*offdate, ctype*
	Measurement.	*edepth, hang, vang, descrip*
	Administrative.	*lddate*
Description:	Station-Channel information. This relation describes the orientation of a recording channel at the site referenced by *sta*. This relation provides information about the various channels (e.g. sz, lz, iz) that are available at a station and maintains a record of the physical channel configuration at a site.	

Name:	**sregion**	
Keys:	Primary.	*srn*
Data:	Descriptive.	*srname*
	Administrative.	*lddate*
Description:	Seismic regions. This is a static relation containing seismic region numbers and their equivalent English names. (See Flinn et al., BSSA, v64, p2, July, 1974.)	

Name:	**stamag**	
Keys:	Primary.	*magid, sta*
	Foreign.	*arid, orid, evid, commid*
Data:	Descriptive.	*phase, magtype*
	Measurement.	*magnitude, uncertainty*
	Administrative.	*auth, lddate*
Description:	Station magnitude. This table summarizes station magnitude estimates based upon measurements made on specific seismic phases. See **netmag**.	

Name:	**stassoc**	
Keys:	Primary.	*stassid*
	Foreign.	*commid*
Data:	Descriptive.	*sta, etype, location*
	Measurement.	*dist, azimuth, lat, lon, depth, time, imb, ims, iml*
	Administrative.	*auth, lddate*
Description:	Summary information on groups of related arrivals. This table defines the group of phases seen at a single station from the same event.	

Name:	**wfdisc**	
Keys:	Primary.	*sta, chan, time*
	Alternate.	*wfid*
	Foreign.	*chanid, commid*
Convenience:	*jdate, endtime*	
Data:	Descriptive.	*nsamp, samprate, calib, calper, instype, segtype, datatype, clip, dir, dfile, foff*
	Administrative.	*lddate*
Description:	Waveform header file and descriptive information. This relation provides a pointer (or index) to waveforms stored on disk. The waveforms themselves are stored in ordinary disk files called wfdisc or .w files, containing only a sequence of sample values (usually in binary representation).	

Name:	**wftag**	
Keys:	Primary.	*tagname, tagid, wfid*
Data:	Administrative.	*lddate*
Description:	Waveform mapping file. The **wftag** relation links various identifiers, e.g. origin id, arrival id, stassoc id, to waveform id. All of the linkages could be determined indirectly using *sta*, *chan* and *time*. However, it is more efficient to predetermine them.	

Name:	**wftape**	
Keys:	Primary.	*sta, chan, time*
	Alternate.	*wfid*
	Foreign.	*chanid, commid*
Convenience:	*jdate, endtime*	
Data:	Descriptive.	*nsamp, samprate, calib, calper, instype, segtype, datatype, clip, dir, dfile*
	Administrative.	*volname, tapefile, tapeblock, lddate*
Description:	Waveform header file and descriptive information. This relation provides a pointer or index to waveforms that have been archived on official Center archive tapes. This is a companion relation to **wfdisc.**	

4.0 DATABASE ATTRIBUTES

This chapter describes each of the attributes used in the Version 3.0 Schema. Descriptions of the relations are found in Chapter 3, *Database Relations*. Attributes are presented as follows:

Name:	*This is the name of the attribute.*
Relation:	**These are the database relations which contain the attribute.**
Description:	This paragraph describes the attribute.
ORACLE:	This identifies the ORACLE data type.
NA Value:	This is a value used to indicate that information is not available for this attribute. Many attributes in this schema are optional. The NA value is defined for these attributes and should be used when the actual value is not known. Essential attributes must always be given a value; they are documented as NA Value NOT ALLOWED.
Units:	This lists the unit of measurement for the attribute, if applicable.
Range:	This is the range of permissible or recommended values for this attribute, if such a range exists. For most strings, the range indicates the recommended values, but is not restricted to those values.

The following conventions are applied throughout.

Dates and Times

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 attribute, *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).

Units of Measurement

Attribute descriptions also include the unit of measurement, if applicable. Here are some quantities with their corresponding measurement units:

period, time	seconds	*calper*, *time*, *endtime*, etc.
julian date	YYYYDOY	*jdate*
amplitude	nanometers	Note that long-period measurements are frequently reported in microns so conversion is required.
angular measurements	degrees	*delta*, *azimuth*, etc.
depth, errors in location	kilometers	*deast*, *depdp*, *depth*, etc.

NA Values

Whenever possible, explicit ranges are defined for each attribute. This is important for data integrity and prepares us for future database management systems which will perform range checking automatically. When the range consists of some element in a finite set, we use the notation {e1 | e2 | ... | en } where "|" denotes the logical OR operation. No range is documented for attributes whose value may be any floating point number.

Sometimes no information is available for an attribute. In that case, an NA (NOT AVAILABLE) value is assigned. An NA value is outside the range of permissible or recommended values for the attribute. This special NA value alerts users and applications that the desired attribute was not available when the record was created. For example, in the **origin** relation, the attribute *ms*, surface wave magnitude, may be unknown for a given record, since it often can't be measured. Then the NA value for magnitudes (–999.0) should be assigned to *ms* and *msid* should be set to –1, the NA value for *msid*. Some attributes are essential to defining a meaningful record and they must be specified; the NA value is not allowed. For example, the attribute *time* in **arrival** must be given a value in the valid range, not an NA value. Another example is *magnitude* in **netmag** and **stamag**. *Magnitude* must be given a meaningful value for each record, so there is no NA value defined.

Some general guidelines and specific examples of NA values are given in the following table.

Representative NA Values:

character fields	- (a dash)
non-negative integer numbers	–1
non-negative real numbers	–1.0
negative real numbers	–999.0
conf	0.0
deast, dnorth	0.0
endtime	+9999999999.999
time	–9999999999.999

In Versions 2.7 and 2.8 of the schema, the underscore "_" was used to denote an unavailable character string. Since the underscore "_" represents the ANSI SQL "match any single character" wildcard, Version 3.0 uses the dash "-" to denote an unknown character string.

ORACLE NULL

An NA value should not be confused with an ORACLE NULL. NA values are supplied by users, while ORACLE inserts the database NULL when no value is specified. An attribute containing a database NULL appears blank when selected within SQL*Plus. When creating a table, an attribute may be constrained as NOT NULL to require the user to supply a value. The ORACLE DESCRIBE command will identify such fields as NOT NULL. There is no intended correlation between ORACLE NOT NULL requirements and Center Version 3.0 requirements that an attribute must be specified.

Format of Character Data

Most character fields are lowercase. The following two lists of attributes define the exceptions:

Uppercase:	*auth, instype, grname, srname, sta, staname, volname*
Mixed Case:	*phase, iphase, remark*

ORACLE Data Types

The Version 3.0 database uses four of the available ORACLE data types:

VARCHAR	All character data in the database is defined to be VARCHAR(n) where "n" is the number of characters in the string (not including a null terminator as in C strings).
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	ORACLE supports the FLOAT(n) data type where "n" is the number of binary digits. FLOAT allows the approximation of single and double precision floats commonly used in scientific programming. The decimal point may be specified anywhere from the first to the last digit (or not at all). All real numbers in the database are single precision FLOAT(24), except for *time* and *endtime* which are double precision FLOAT(53).
DATE	The only field in the database which is declared to be the ORACLE DATE data type is the *lddate* field which stores the day and time a record was inserted into the database.

Name:	*algorithm*
Relation:	**origin**
Description:	Location algorithm used. This is a brief textual description of the algorithm used for computing a seismic origin.
ORACLE:	VARCHAR(15)
NA Value:	- (a dash)
Range:	Any string up to 15 characters long

Name:	*amp*
Relation:	**arrival**
Description:	Signal amplitude. This is the zero-to-peak amplitude of the earth's displacement for a seismic phase. *Amp* is assumed to be corrected for the response of the instrument.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Nanometers
Range:	*amp* > 0.0

Name:	*arid*
Relations:	**arrival, assoc, stamag**
Description:	Arrival identifier. Each arrival is assigned a unique positive integer identifying it with a unique *sta, chan* and *time*. This number is used in the **assoc** relation along with the origin identifier to link **arrival** and **origin**.
ORACLE:	NUMBER(8)
NA Value:	–1 Allowed only in **stamag**. A valid entry is required for **arrival** and **assoc**.
Range:	*arid* > 0

Name:	*auth*
Relations:	**arrival, event, netmag, network, origin, stamag, stassoc**
Description:	Author. This records the originator of an arrival (in **arrival** relation) or origin (in **origin** relation). Possibilities include externally supplied arrivals identified according to their original source, such as WMO, NEIS, CAN(adian), UK(array), etc. This may also be an identifier of an application generating the attribute, such as an automated interpretation or signal processing program.
ORACLE:	VARCHAR(15)
NA Value:	- (a dash)
Range:	Any string with no more than 15 upper case characters.

Name:	*azdef*
Relation:	**assoc**
Description:	Azimuth defining code. This is a one character flag that indicates whether or not the azimuth of a phase was used to determine the event's origin. It is defining (*azdef* = d) if used to help locate the event or non-defining (*azdef* = n) if it is not used.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{d | n}, lower case

Name:	*azimuth*
Relations:	**arrival, stassoc**
Description:	Observed azimuth. This is the estimated station-to-event azimuth measured clockwise from north. Azimuth is estimated from f-k or polarization analysis. In **stassoc**, the value may be an analyst estimate.
ORACLE:	FLOAT(24)
NA Value:	-1.0
Units:	Degrees
Range:	$0.0 \leq azimuth < 360.0$

Name:	*azres*
Relation:	**assoc**
Description:	Azimuth residual. This 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.
ORACLE:	FLOAT(24)
NA Value:	-999.0
Units:	Degrees
Range:	$-180.0 \leq azres \leq 180.0$

Name:	*band*
Relation:	**instrument**
Description:	Frequency band. This is a qualitative indicator of frequency pass-band for an instrument. Values should reflect the response curve rather than just the sample rate. Recommended values are s (short-period), m (mid-period), i (intermediate-period), l (long-period), b (broad-band), h (high frequency, very short-period), and v (very long-period). For a better notion of the instrument characteristics, see the instrument response curve.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{s | m | i | l | b | h | v}, lower case.

Name:	*belief*
Relation:	**assoc**
Description:	Phase identification confidence level. This is a qualitative estimate of the confidence that a seismic phase is correctly identified.
ORACLE:	FLOAT(24)
NA Value:	-1.0
Range:	$0.0 \leq belief \leq 1.0$

Name:	*calib*
Relations:	**wfdisc, wftape**
Description:	Calibration factor. This is the conversion factor that maps digital data to earth displacement. The factor holds true at the oscillation period specified by the attribute *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. *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*.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	Nanometers/digital count
Range:	Any non-zero floating point number.

Name:	*calper*
Relations:	**sensor, wfdisc, wftape**
Description:	Calibration period. This gives the period for which *calib*, *ncalib* and *calratio* are valid.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	Seconds
Range:	$calper > 0.0$

Name:	*calratio*
Relation:	**sensor**
Description:	Calibration conversion ratio. This is a dimensionless calibration correction factor which permits small refinements to the calibration correction made using *calib* and *calper* from the **wfdisc** relation. 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** relation. A positive value means ground motion increasing in component direction (up, north, east) is indicated by increasing counts. A negative value means the opposite. *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.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Any non-zero floating quantity.

Name:	*chan*
Relations:	**arrival, sensor, sitechan, wfdisc, wftape**
Description:	Channel identifier. This is an eight-character code, which, taken together with *sta*, *jdate* and *time*, uniquely identifies the source of the seismic data, including the geographic location, spatial orientation, sensor and subsequent data processing.
ORACLE:	VARCHAR(8)
NA Value:	"-" (a dash) Allowed only in **arrival**. A valid entry is required in **sensor, sitechan, wfdisc** and **wftape**.
Range:	Any sequence of up to 8 lower case characters.

Name:	*chanid*
Relations:	**arrival, sensor, sitechan, wfdisc, wftape**
Description:	Channel recording identifier. This is a surrogate key used to uniquely identify a specific recording. *Chanid* duplicates the information of the compound key *sta, chan, time*. As a single identifier it is often convenient. *Chanid* is very database dependent and is included only for backward compatibility with historical databases. *Sta, chan* and *time* is more appropriate to the human interface.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	*chanid* > 0

Name:	*clip*
Relations:	**arrival, wfdisc, wftape**
Description:	Clipped data flag. This is a single-character flag to indicate whether (c) or not (n) the data were clipped. Typically, this flag is derived from status bits supplied with GDSN or RSTN data, but could also be supplied as a result of analyst review.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{c | n}, lower case

Name:	*commid*
Relations:	**arrival, assoc, event, network, netmag, origerr, origin, remark, stamag, stassoc, wfdisc, wftape**
Description:	Comment identification. This is a key used to point to free-form comments entered in the **remark** relation. These comments store additional information about a tuple in another relation. Within the **remark** relation, there may be many tuples with the same *commid* and different *lineno*, but the same *commid* will appear in only one other tuple among the rest of the relations in the database. See *lineno*.
ORACLE:	NUMBER(8)
NA Value:	–1 NOT ALLOWED in **remark** where a valid entry is required.
Range:	*commid* > 0

Name:	*conf*
Relation:	**origerr**
Description:	Error confidence. This attribute denotes the confidence attached to the event attributes *smajax*, *sminax*, *sdepth* and *stime*.
ORACLE:	FLOAT(24)
NA Value:	0.0
Range:	$0.0 < conf \leq 1.0$

Name:	*ctype*
Relation:	**sitechan**
Description:	Channel type. .This attribute specifies the type of data channel: n (normal, a normal instrument response), b (beam, a coherent beam formed with array data), or i (an incoherent beam or energy stack).
ORACLE:	VARCHAR(4)
NA Value:	- (a dash)
Range:	{n | b | i}, lower case

Name: *datatype*

Relations: **wfdisc, wftape**

Description: Numeric data storage. This attribute specifies the format of a data series in the file system. Datatypes i4, f4 and s4 are typical values. Datatype i4 denotes a 4-byte integer and f4 denotes a 32-bit real number in DEC/VAX format. s4 is an integer where the most significant byte is in the low address position in memory (used by Motorola and Sun chipsets) and is opposite to the order used on DEC and Intel chipsets. Machine dependent formats are supported for common hardwares to allow data transfer in native machine binary formats. ASCII formats have also been defined to retain full precision of any binary data type. ASCII may be used when exchanging data between computer systems with incompatible binary types. See the "wfport" command manual page for information about converting formats. *Datatype* can only describe single values or arrays of one data type.

ORACLE: VARCHAR(2)

NA Value: - (a dash)

Range: The currently recognized types (lower case is mandatory) are:

legal datatype values

datatype 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 IEEE single precision real
t8	8	SUN IEEE double precision real
s4	4	SUN IEEE integer
s2	2	SUN IEEE short 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
g2	2	NORESS gain-ranged

Name: *deast*

Relation: **site**

Description: Distance east. This attribute gives the "easting" or relative position of an array element, east of the location of the array center specified by the value of *refsta*. See *dnorth*.

ORACLE: FLOAT(24)

NA Value: 0.0

Units: Kilometers

Range: $-20{,}000.0 \leq deast \leq 20{,}000.0$

Name:	*delaz*
Relation:	**arrival**
Description:	Delta azimuth. This attribute gives the standard deviation of the azimuth of a signal.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Degrees
Range:	*delaz* > 0.0

Name:	*delslo*
Relation:	**arrival**
Description:	Delta slowness. This attribute gives the standard deviation of the slowness of a signal.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Seconds (of time)/degree
Range:	*delslo* > 0.0

Name:	*delta*
Relation:	**assoc**
Description:	Source-receiver distance. This attribute 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 attribute *orid*. The attribute *arid* points to the record in the **arrival** relation that identifies the receiver. The value of the attribute can exceed 180 degrees, it can even exceed 360 degrees. The geographic distance between source and receiver is *delta* mod(180).
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Degrees
Range:	*delta* ≥ 0.0

Name:	*deltim*
Relation:	**arrival**
Description:	Delta time. This attribute gives the standard deviation of a detection time.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Seconds
Range:	*deltim* > 0.0

Name:	*depdp*
Relation:	**origin**
Description:	Depth as estimated from depth phases. This 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*.
ORACLE:	FLOAT(24)
NA Value:	–999.0
Units:	Kilometers
Range:	$0.0 \leq depdp < 1000.0$

Name:	*depth*
Relations:	**origin, stassoc**
Description:	Source depth. This attribute gives the depth of the event origin. In **stassoc** this may be an analyst estimate.
ORACLE:	FLOAT(24)
NA Value:	–999.0 **origin.**
Units:	Kilometers
Range:	$0.0 \leq depth < 1000.0$

Name:	*descrip*
Relation:	**sitechan**
Description:	Channel description. This is a description of the data channel. For non-instrument channels (e.g. beams) this can be the only quantitative description of channel operations in the core tables.
ORACLE:	VARCHAR(50)
NA Value:	- (a dash)
Range:	Any free-format string up to 50 characters

Name:	*dfile*
Relations:	**instrument, wfdisc, wftape**
Description:	Data file. In **wfdisc**, this is the file name of a disk-based waveform file. In **instrument**, this points to an instrument response file. See *dir*.
ORACLE:	VARCHAR(32)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Any free-format string up to 32 characters long

Name:	*digital*
Relation:	**instrument**
Description:	Digital/Analog. This attribute is a single character flag denoting whether this instrument record describes an analog or digital recording system.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{d | a}, lower case

Name:	*dir*
Relations:	**instrument, wfdisc, wftape**
Description:	Directory. This attribute is the directory-part of a path name. Relative path names or "." (dot), the notation for the current directory, may be used.
ORACLE:	VARCHAR(64)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Any string up to 64 characters long

Name:	*dist*
Relation:	**stassoc**
Description:	Estimated distance. This attribute gives the approximate source-receiver distance as calculated from slowness (array measurements only), incident angle, or (S-P) times.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Degrees
Range:	$0.0 \leq dist \leq 180.0$

Name:	*dnorth*
Relation:	**site**
Description:	Distance north. This attribute gives the "northing" or relative position of array element north of the array center specified by the value of *refsta*. See *deast*.
ORACLE:	FLOAT(24)
NA Value:	0.0
Units:	Kilometers
Range:	$-20{,}000.0 \leq dnorth \leq 20{,}000.0$

Name:	*dtype*
Relation:	**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 recommended values are f (free), d (from depth phases), r (restrained by location program) or g (restrained by geophysicist). In cases r or g, either the *auth* field should indicate the agency or person responsible for this action, or the *commid* field should point to an explanation in the **remark** relation.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{f | d | r | g}, lower case

Name:	*edepth*
Relation:	**sitechan**
Description:	Emplacement depth. This attribute gives the depth at which the instrument is positioned, relative to the value of *elev* in the **site** relation.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	Kilometers
Range:	*edepth* ≥ 0.0

Name:	*elev*
Relations:	**site**
Description:	Elevation. This attribute is the elevation of a seismic station relative to mean sea level.
ORACLE:	FLOAT(24)
NA Value:	-999.0
Units:	Kilometers
Range:	$-10.0 \leq$ *elev* ≤ 10.0

Name:	*ema*
Relation:	**arrival**
Description:	Emergence angle. This attribute is the emergence angle of an arrival, as observed at a three-component station or array. The value increases from the vertical direction towards the horizontal.
ORACLE:	FLOAT(24)
NA Value:	-1.0
Units:	Degrees
Range:	$0.0 \leq$ *ema* ≤ 90.0

Name:	*emares*
Relation:	**assoc**
Description:	Emergence angle residual. This attribute 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*.
ORACLE:	FLOAT(24)
NA Value:	–999.0
Units:	Degrees
Range:	$-90.0 \leq emares \leq 90.0$

Name:	*endtime*
Relations:	**sensor, wfdisc, wftape**
Description:	Time of last datum. In **wfdisc** and **wftape**, this attribute is the time of the last sample in the waveform file. *Endtime* is equivalent to *time* + (*nsamp* – 1)/*samprate*. In **sensor**, this is the last time the data in the record are valid.
ORACLE:	FLOAT(53)
NA Value:	+9999999999.999
Units:	Epochal seconds
Range:	*endtime* > *time*

Name:	*esaz*
Relation:	**assoc**
Description:	Event to station azimuth. This attribute is the calculated event-to-station azimuth, measured in degrees clockwise from North.
ORACLE:	FLOAT(24)
NA Value:	–999.0
Units:	Degrees
Range:	$0.0 \leq esaz \leq 360.0$

Name: *etype*

Relations: **origin, stassoc**

Description: Event type. This attribute is used to identify the type of seismic event, when known. For *etypes* l, r, t the value in **origin** will be the value determined by the station closest to the event.

ORACLE: VARCHAR(7)

NA Value: - (a dash)

Range: The recommended codes (all lower case) are:

etype values

etype code	meaning of code
qb	Quarry blast or mining explosion
eq	Earthquake
me	Marine explosion
ex	Other explosion
o	Other source of known origin
l	Local event of unknown origin
r	Regional event of unknown origin
t	Teleseismic event of unknown origin

Name: *evid*

Relations: **event, netmag, origin, stamag**

Description: Event identifier. Each event is assigned a unique positive integer which identifies it in a database. It is possible for several records in the **origin** relation to have the same *evid.* This indicates there are several opinions about the location of the event.

ORACLE: NUMBER(8)

NA Value: –1 Allowed in **netmag, origin** and **stamag.** A valid entry is required in **event.**

Range: *evid* > 0

Name: *evname*

Relation: **event**

Description: Event name. This is the common name of the event identified by *evid.*

ORACLE: VARCHAR(15)

NA Value: - (a dash)

Range: Any free-format string up to 15 characters long.

Name:	*fm*
Relation:	**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 (dilation) on a short-period sensor is denoted by c(d) and compression (dilation) on a long-period sensor is denoted by u(r). Empty character positions will be indicated by dots (e.g., ".r").
ORACLE:	VARCHAR(2)
NA Value:	- (a dash)
Range:	All two-letter permutations of {c | d | . }, {u | r | . }, lower case

Name:	*foff*
Relation:	**wfdisc**
Description:	File offset. This is the byte offset of a waveform segment within a data file. It is used when data are multiplexed. See *dir* and *dfile*.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	*foff* ≥ 0

Name:	*grn*
Relations:	**gregion, origin**
Description:	Geographic region number. This is a geographic region number, as defined by Flinn, Engdahl and Hill (Bull. Seism. Soc. Amer. vol 64, pp. 771-992, 1974). See *grname*.
ORACLE:	NUMBER(4)
NA Value:	–1 Allowed only in **origin**. A valid entry is required in **gregion**.
Range:	*grn* > 0

Name:	*grname*
Relation:	**gregion**
Description:	Geographic region name. This attribute is the common name of a geographic region, as given in Flinn, Engdahl and Hill (Bull. Seism. Soc. Amer., vol 64, pp 771-992, 1974). Names may have changed due to changing political circumstances (e.g., old RHODESIA = new ZIMBABWE). See *grn* and *srname*.
ORACLE:	VARCHAR(40)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Any upper-case string up to 40 characters long

Name:	*hang*
Relation:	**sitechan**
Description:	Horizontal orientation of seismometer. This attribute 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.; for East-West orientation with the seismometer pointing toward the west, *hang*=270. See *vang*.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	Degrees
Range:	$0.0 \leq hang \leq 360.0$

Name:	*imb*
Relation:	**stassoc**
Description:	Initial body wave magnitude. This is an analyst's estimate of the body wave magnitude using data from a single station. See *iml*, *ims*, *magnitude*, *magtype*, *mb*, *ml* and *ms*.
ORACLE:	FLOAT(24)
NA Value:	-999.0

Name:	*iml*
Relation:	**stassoc**
Description:	Initial local magnitude. This is an analyst's estimate of the local magnitude using data from a single station. See *imb*, *ims*, *magnitude*, *magtype*, *mb*, *ml* and *ms*.
ORACLE:	FLOAT(24)
NA Value:	-999.0

Name:	*ims*
Relation:	**stassoc**
Description:	Initial surface wave magnitude. This is an analyst's estimate of surface wave magnitude using data from a single station. See *magnitude*, *magtype*, *mb*, *ml*, *ms*, *imb* and *iml*.
ORACLE:	FLOAT(24)
NA Value:	-999.0

Name:	*inid*
Relations:	**instrument, sensor**
Description:	Instrument identifier. This is a unique key to the **instrument** relation. *Inid* provides the only link between **sensor** and **instrument**.
ORACLE:	NUMBER(8)
NA Value:	-1 Allowed only in **sensor**. A valid entry is required for **instrument**.
Range:	$inid > 0$

Name:	*insname*
Relation:	**instrument**
Description:	Instrument name. This is a character string containing the name of the instrument.
ORACLE:	VARCHAR(50)
NA Value:	- (a dash)
Range:	Any free-format string up to 50 characters long.

Name:	*instant*
Relation:	**sensor**
Description:	Snapshot indicator. When this attribute has the value *instant* = "y", it means that the snapshot was taken at the time of a discrete procedural change, such as an adjustment of the instrument gain; n means the snapshot is of a continuously changing process, such as calibration drift. This is important for tracking time corrections and calibrations.
ORACLE:	VARCHAR(1)
NA Value:	NOT ALLOWED. If the value is unknown, default to "y".
Range:	{y | n}

Name:	*instype*
Relations:	**instrument, wfdisc, wftape**
Description:	Instrument type. This character string is used to indicate the instrument type. Some examples are: SRO, ASRO, DWWSSN, LRSM, and S-750.
ORACLE:	VARCHAR(6)
NA Value:	- (a dash)
Range:	Upper case and too numerous to mention, but see "Directory of World Digital Seismic Station", Ganse & Hutt, World Data Center A, Report SE-32, August, 1982.

Name:	*iphase*
Relation:	**arrival**
Description:	Reported phase. This eight-character field holds the name initially given to a seismic phase. Standard seismological labels for the types of signals (or phases) are used (e.g., 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*.
ORACLE:	VARCHAR(8)
NA Value:	- (a dash)
Range:	Any string up to 8 characters long which conforms to seismological practice.

Name:	*jdate*
Relations:	**arrival, origin, sensor, wfdisc, wftape**
Description:	Julian date. This attribute is the 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. Note: there is no year = 0000 or day = 000. Where only the year is known, day of year = 001; where only year and month are known, day of year = first day of month. Note: only the year is negated for BC, so Jan 1 of 10 BC is –0010001. See *time*.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	Julian dates of the form yyyyddd. Must be consistent with the accompanying *time* attribute.

Name:	*keyname*
Relation:	**lastid**
Description:	Identifier type. This attribute contains the actual name of a key whose last assigned numeric value is saved in *keyvalue*.
ORACLE:	VARCHAR(15)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	{arid | chanid | commid | evid | inid | orid | stassid | wfid}, lower case

Name:	*keyvalue*
Relation:	**lastid**
Description:	Current identifier value. This attribute maintains the last assigned value (a positive integer) of the counter for the specified *keyname*. The number *keyvalue* is the last counter value used for the attribute *keyname*. Key values are maintained in the database to ensure uniqueness.
ORACLE:	NUMBER(8).
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	*keyvalue* > 0

Name:	*lat*
Relations:	**origin, site, stassoc**
Description:	Latitude. This attribute is the geographic latitude. Locations north of the equator have positive latitudes.
ORACLE:	FLOAT(24)
NA Value:	–999.0 Allowed only in **stassoc**. A valid entry is required in **origin** and **site**.
Units:	Degrees
Range:	$-90.0 \leq lat \leq +90.0$

Name: *lddate*
Relations: **all**
Description: Load date. This is the date and time the record was inserted into the database.
ORACLE: DATE
Range: Any valid date.

Name: *lineno*
Relation: **remark**
Description: Comment line number. This integer attribute is assigned as a sequence number for multiple line comments. The combination of *commid* and *lineno* is unique.
ORACLE: NUMBER(4)
NA Value: NOT ALLOWED. A valid entry is required.
Range: *lineno* > 0

Name: *location*
Relation: **stassoc**
Description: Location description. This character string describes the location of an event identified from data recorded at a single station. Two examples are Fiji-Tonga and Semipalatinsk.
ORACLE: VARCHAR(32)
NA Value: - (a dash)
Range: Any free-format string up to 32 characters long

Name: *logat*
Relation: **arrival**
Description: Log of amplitude divided by period. This measurement of signal size is often reported instead of the amplitude and period separately. This attribute is only filled if the separate measurements are not available.
ORACLE: FLOAT(24)
NA Value: –999.0
Units: Log (Nanometers/seconds)

Name: *lon*
Relations: **origin, site, stassoc**
Description: Longitude. This attribute is the geographic longitude in degrees. Longitudes are measured positive east of the Greenwich meridian.
ORACLE: FLOAT(24)
NA Value: –999.0 Allowed only in **stassoc**. A valid entry is required in **origin** and **site**.
Units: Degrees
Range: $-180.0 \leq lon \leq +180.0$

Name:	*magid*
Relations:	**netmag, stamag**
Description:	Network magnitude identifier. This key is assigned to identify a network magnitude in the **netmag** relation. It 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*.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	*magid* > 0

Name:	*magnitude*
Relations:	**netmag, stamag**
Description:	Magnitude. This gives the magnitude value of the type indicated in attribute *magtype*. It is derived in a variety of ways, which are not necessarily linked directly to an arrival. See *imb*, *iml*, *ims*, *magtype*, *mb*, *ml* and *ms*.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. An entry is required to define a valid record.

Name:	*magtype*
Relations:	**netmag, stamag**
Description:	Magnitude type. This character string is used to specify whether the *magnitude* value represents *mb* (body wave magnitude), *ms* (surface wave magnitude), *ml* (local magnitude) or other appropriate magnitude measure. See *imb*, *iml*, *ims*, *magnitude*, *mb*, *ml*, *ms*.
ORACLE:	VARCHAR(6)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Any free-format string up to 6 characters long.

Name:	*mb*
Relation:	**origin**
Description:	Body wave magnitude. This is the body wave magnitude of an event. Associated with this attribute is the identifier *mbid* which points to *magid* in the **netmag** relation. The information in that record summarizes the method of analysis and data used. See *imb*, *iml*, *ims*, *magnitude*, *magtype*, *ml* and *ms*.
ORACLE:	FLOAT(24)
NA Value:	-999.0

Name:	*mbid*
Relation:	**origin**
Description:	Magnitude identifier for *mb*. This stores the *magid* for a record in **netmag**. *Mbid* is a foreign key joining **origin** to **netmag** where **origin**.*mbid* = **netmag**.*magid*. See *magid*, *mlid* and *msid*.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	*mbid* > 0

Name:	*ml*
Relation:	**origin**
Description:	Local magnitude. This is the local magnitude of an event. Associated with this attribute is the identifier *mlid*, which points to *magid* in the **netmag** relation. The information in that record summarizes the method of analysis and the data used. See *imb*, *iml*, *ims*, *magnitude*, *magtype*, *mb* and *ms*.
ORACLE:	FLOAT(24)
NA Value:	–999.0

Name:	*mlid*
Relation:	**origin**
Description:	Magnitude identifier for *ml*. This stores the *magid* for a record in **netmag**. *Mlid* is a foreign key joining **origin** to **netmag** where **origin**.*mlid* = **netmag**.*magid*. See *magid*, sid *and mbid.*
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	*mlid* > 0

Name:	*ms*
Relation:	**origin**
Description:	Surface wave magnitude. This is the surface wave magnitude for an event. Associated with this attribute is the identifier *msid*, which points to *magid* in the **netmag** relation. The information in that record summarizes the method of analysis and the data used. See *imb*, *iml*, *ims*, *magnitude*, *magtype*, *mb* and *ml*.
ORACLE:	FLOAT(24)
NA Value:	–999.0

Name:	*msid*
Relation:	**origin**
Description:	Magnitude identifier for *ms*. This stores the *magid* for a record in **netmag**. *Msid* is a foreign key joining **origin** to **netmag** where **origin**.*msid* = **netmag**.*magid*. See *magid*, *mlid* and *mbid*.
ORACLE:	NUMBER(8)
NA Value:	-1
Range:	*msid* > 0

Name:	*nass*
Relation:	**origin**
Description:	Number of associated arrivals. This attribute gives the number of arrivals associated with the origin.
ORACLE:	NUMBER(8)
NA Value:	-1
Range:	*nass* > 0

Name:	*ncalib*
Relation:	**instrument**
Description:	Nominal calibration factor. This is the conversion factor that 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** relations. See *calratio*.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	Nanometers/digital count
Range:	Any non-zero floating point number

Name:	*ncalper*
Relation:	**instrument**
Description:	Calibration period. This attribute is the period for which *ncalib* is valid.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	seconds
Range:	*ncalper* > 0.0

Name:	*ndef*
Relation:	**origin**
Description:	Number of time-defining phases. This attribute is the number of arrivals used to locate an event. See *timedef*.
ORACLE:	NUMBER(4)
NA Value:	–1
Range:	$0 < ndef \leq nass$

Name:	*ndp*
Relation:	**origin**
Description:	Number of depth phases. This attribute gives the number of depth phases used in calculating *depth* and/or *depdp*. See *depdp*.
ORACLE:	NUMBER(4)
NA Value:	–1
Range:	$ndp \geq 0$

Name:	*net*
Relations:	**affiliation, netmag, network**
Description:	Unique network identifier. This character string is the name of a seismic network. One example is WWSSN.
ORACLE:	VARCHAR(8)
NA Value:	- (a dash) Allowed only in **netmag**. A valid entry is required in **affiliation** and **network**.
Range:	Any free-format string up to 8 characters

Name:	*netname*
Relation:	**network**
Description:	Network Name. String containing the name of a network.
ORACLE:	VARCHAR(80)
NA Value:	- (a dash)
Range:	Any string up to 80 characters

Name:	*nettype*
Relation:	**network**
Description:	Network type. This 4 character string specifies what type of network (ar = array), (lo = local area), (ww = world-wide) for the given value of *net*.
ORACLE:	VARCHAR(4)
NA Value:	- (a dash)
Range:	Any lower case string up to 4 characters

Name:	*nsamp*
Relations:	**wfdisc, wftape**
Description:	Number of samples. This quantity is the number of samples in a waveform segment.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	*nsamp* > 0

Name:	*nsta*
Relation:	**netmag**
Description:	Number of stations. This quantity is the number of stations used to compute the magnitude of the event.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	*nsta* > 0

Name:	*offdate*
Relations:	**site, sitechan**
Description:	Turn off date. This attribute is the Julian Date on which the station or sensor indicated was turned off, dismantled, or moved. See *ondate*.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	Julian date of the form yyyyddd

Name:	*ondate*
Relations:	**site, sitechan**
Description:	Turn on date. This attribute is the Julian Date on which the station or sensor indicated began operating. *Offdate* and *ondate* are not intended to accommodate temporary downtimes, but rather to indicate the time period for which the attributes of the station (*lat, lon, elev*) are valid for the given station code. Stations are often moved, but with the station code remaining unchanged.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Julian date of the form yyyyddd

Name:	*orid*
Relations:	**assoc, netmag, origerr, origin, stamag**
Description:	Origin identification. Each origin is assigned a unique positive integer which identifies it in a data base. The *orid* is used to identify one of the many hypotheses of the actual location of the event.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required for all relations.
Range:	*orid* > 0

Name:	*per*
Relation:	**arrival**
Description:	Signal period. This attribute is the period of the signal described by the **arrival** record.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Seconds
Range:	*per* > 0.0

Name:	*phase*
Relations:	**assoc, stamag**
Description:	Associated phase. This field holds the identity of a seismic phase which has been associated to an event. Standard seismological labels for phases are used (e.g., P, PKP, PcP, pP, etc.). Both upper and lower case letters are available and should be used when appropriate, for example, pP or PcP. See *iphase*.
ORACLE:	VARCHAR (8)
NA Value:	- (a dash)
Range:	Any string up to 8 characters long which conforms to seismological practice.

Name:	*prefor*
Relation:	**event**
Description:	Preferred origin. This attribute holds the origin identifier, *orid*, that points to the preferred origin for a seismic event.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	*prefor* > 0

Name:	*qual*
Relation:	**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.
ORACLE:	VARCHAR (1)
NA Value:	- (a dash)
Range:	{i | e | w}, lower case

Name:	*rect*
Relation:	**arrival**
Description:	Rectilinearity. This attribute is a measure of signal rectilinearity. The value is obtained from polarization analysis of 3-component data.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Range:	$0.0 \leq rect \leq 1.0$

Name:	*refsta*
Relation:	**site**
Description:	Reference station. This string specifies the reference station with respect to which array members are located. See *deast, dnorth.*
ORACLE:	VARCHAR (6)
NA Value:	- (a dash)
Range:	Any *sta* from **site**.

Name:	*remark*
Relation:	**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'' relation only by forward reference from *commid* in the tuple of the relation of interest. See *commid* and *lineno.*
ORACLE:	VARCHAR(80)
NA Value:	- (a dash)
Range:	Any free-format string up to 80 characters long

Name: *rsptype*

Relation: **instrument**

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

ORACLE: VARCHAR(6)

NA Value: NOT ALLOWED. A valid entry is required.

Range: Any lower case string up to 6 characters long

Name: *samprate*

Relations: **instrument, wfdisc, wftape**

Description: Sampling rate. This attribute is the sample rate in samples/second. In the **instrument** relation this 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.

ORACLE: FLOAT(24)

NA Value: NOT ALLOWED. A valid entry is required.

Units: 1/seconds

Range: *samprate* > 0.0

Name: *sdepth*

Relation: **origerr**

Description: Depth error. This is the maximum error of a depth estimate for a level of confidence given by *conf*. See *smajax, sminax, stx*.

ORACLE: FLOAT(24)

NA Value: –1.0

Units: Kilometers

Range: *sdepth* > 0.0

Name: *sdobs*

Relation: **origerr**

Description: Standard error of one observation. This attribute is derived from the discrepancies in the arrival times of the phases used to locate an event. It 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).

ORACLE: FLOAT(24)

NA Value: –1.0

Range: *sdobs* > 0.0

Name:	*seaz*
Relation:	**assoc**
Description:	Station to event azimuth. This attribute is calculated from the station and event locations. It is measured clockwise from North.
ORACLE:	FLOAT(24)
NA Value:	-999.0
Units:	Degrees
Range:	$0.0 \leq seaz \leq 360.0$

Name:	*segtype*
Relations:	**wfdisc, wftape**
Description:	Segment type. This attribute indicates if a waveform is o (original), v (virtual), s (segmented) or d (duplicate).
ORACLE:	VARCHAR (1)
NA Value:	- (a dash)
Range:	{o | v | s | d}, lower case

Name:	*slodef*
Relation:	**assoc**
Description:	Slowness defining code. This one-character flag indicates whether or not the slowness of a phase is d (defining), or n (non-defining) for this arrival. See *azdef* and *timedef*.
ORACLE:	VARCHAR (1)
NA Value:	- (a dash)
Range:	{d | n}

Name:	*slores*
Relation:	**assoc**
Description:	Slowness residual. This attribute 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.
ORACLE:	FLOAT(24)
NA Value:	-99999.0
Units:	Seconds/degree

Name:	*slow*
Relation:	**arrival**
Description:	Observed slowness. This is the observed slowness of a wave as it sweeps across an array.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Seconds/degree
Range:	*slow* ≥ 0.0

Name:	*smajax*
Relation:	**origerr**
Description:	Semi-major axis of error ellipse for a given confidence. This is the length of the semi-major axis of the location error ellipse. It is found by projecting the covariance matrix onto the horizontal plane. The level of confidence is specified by *conf*. See *sdepth*, *sminax* and *stx*.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Kilometers
Range:	*smajax* > 0.0

Name:	*sminax*
Relation:	**origerr**
Description:	Semi-minor axis of error ellipse. This is the length of the semi-minor axis of the location error ellipse. It is found by projecting the covariance matrix onto the horizontal plane. The level of confidence is specified by *conf*. See *sdepth*, *smajax* and *stx*.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Kilometers
Range:	*sminax* > 0.0

Name:	*snr*
Relation:	**arrival**
Description:	Signal-to-noise ratio. This is an estimate of the size of the signal relative to that of the noise immediately preceding it.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Range:	*snr* > 0.0

Name:	*srn*
Relations:	**origin, sregion**
Description:	Region number. This is a seismic region number, as given by Flinn, Engdahl and Hill (Bull. Seism. Soc. Amer. vol 64, pp 791-992, 1974). See *grn*, *grname* and *srname*.
ORACLE:	NUMBER(8)
NA Value:	-1 Allowed only in **origin**. A valid entry is required in **sregion**.
Range:	*srn* > 0

Name:	*srname*
Relation:	**sregion**
Description:	Seismic region name. This attribute is the common name of a seismic region, as given in Flinn, Engdahl and Hill (Bull. Seism. Soc. Amer., vol 64, pp 771-992, 1974). Names may have changed due to changing political circumstances (e.g., old RHODESIA = new ZIMBABWE). See *srn* and *grname*.
ORACLE:	VARCHAR(40)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	Any upper-case string up to 40 characters long

Name:	*sta*
Relations:	**affiliation, arrival, assoc, sensor, site, sitechan, stamag, stassoc, wfdisc, wftape**
Description:	Station code. This is the common code-name of a seismic observatory. Generally only three or four characters are used.
ORACLE:	VARCHAR (6)
NA Value:	"-" (a dash) Allowed only in **stassoc**. A valid entry is required for all other relations.
Range:	Any upper case string up to 6 characters long

Name:	*staname*
Relation:	**site**
Description:	Station name/description. This is the full name of the station whose code-name is in *sta*. As an example, one record in the **site** relation connects *sta* = ANMO to *staname* = ALBUQUERQUE, NEW MEXICO (SRO).
ORACLE:	VARCHAR (50)
NA Value:	- (a dash)
Range:	Any upper-case string up to 50 characters long

Name:	*stassid*
Relations:	**arrival, stassoc**
Description:	Station association identification. The wavetrain from a single event may be made up of a number of arrivals. A unique *stassid* joins those arrivals believed to have come from a common event as measured at a single station. *Stassid* is also the key to the **stassoc** relation, which contains additional signal measurements not contained within the **arrival** relation, such as station magnitude estimates and computed signal characteristics.
ORACLE:	NUMBER(8)
NA Value:	–1 Allowed only in **arrival.**
Range:	*stassid* > 0

Name:	*statype*
Relation:	**site**
Description:	Station type. This character string specifies the station type. Recommended entries are ss (single station) or ar (array).
ORACLE:	VARCHAR (4)
NA Value:	- (a dash)
Range:	{ss | ar}, lower case

Name:	*stime*
Relation:	**origerr**
Description:	Origin time error. This attribute denotes the time uncertainty that accompanies the location. The level of confidence is specified by *conf.* See *smajax, sminax,* and *sdepth.*
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Seconds
Range:	*stime* ≥ 0.0

Name:	*strike*
Relation:	**origerr**
Description:	Strike of major axis of error ellipse. This attribute is the strike of the semi-major axis of the location error ellipse, measured in degrees clockwise from North. See *smajax.*
ORACLE:	FLOAT(24)
NA Value:	–1.0
Units:	Degrees
Range:	0.0 ≤ *strike* ≤ 360.0

Name:	*stx, sty, stz, sxx, sxy, sxz, syy, syz, stt, szz*
Relation:	**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*, etc., (x,y,z,t) refer to latitude, longitude, depth and origin time, respectively. These attributes (together with *sdobs*, *ndef* and *dtype*) provide all the information necessary to construct the K-dimensional (K=2,3,4) confidence ellipse or ellipsoids at any confidence limit desired.
ORACLE:	FLOAT(24)
NA Value:	-1.0
Units:	*sxx,syy,szz,sxy,szx,syz* - kilometers squared, *stt* - seconds squared, *stx,sty,stz* - km/sec
Range:	*sxx, syy, szz, stt* > 0.0

Name:	*stype*
Relation:	**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 (i.e., non-seismic detection) c = calibration activity upsets the date l, r, and t are supplied by the reporting station, or as an output of post-detection processing. g and c come from analyst comment or from status bits from GDSN and RSTN data.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{l | r | t | m | g | c}, lower case

Name:	*tagid*
Relation:	**wftag**
Description:	Tagname value. This 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*.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	*tagid* > 0

Name:	*tagname*
Relation:	**wftag**
Description:	Tagname type. This is the name of the foreign key whose value is in *tagid*.
ORACLE:	VARCHAR(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	{arid | evid | orid | stassid}

Name:	*tapeblock*
Relation:	**wftape**
Description:	Tape block number. This attribute gives the first block (in some file of an ANSI-labeled tape) at which a time series begins. The dearchiving program uses this number to skip blocks within a tape file in order to retrieve the waveform specified. See *tapefile*.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	*tapeblock* > 0

Name:	*tapefile*
Relation:	**wftape**
Description:	Tape file number. This attribute gives the file number (on a tape) at which a time-series is written. A tape begins with file 1. This number can be used to skip files when retrieving data from the tape. See *tapeblock*.
ORACLE:	NUMBER(8)
NA Value:	–1
Range:	*tapefile* > 1

Name:	*time*
Relations:	**arrival, origin, sensor, stassoc, wfdisc, wftape**
Description:	Epoch time. Epochal time given as seconds and fractions of a second since hour 0 January 1, 1970, and stored in a double precision floating number. Refers to the relation data object with which it is found. E.g., in **arrival** - arrival time; in **origin** - origin time; in **wfdisc**, - start time of data. Where 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 the time attribute is set to the NA value. The double-precision floating point number allows 15 decimal digits. At 1 millisecond accuracy this is a range of $3 * 10^4$ years. Where time is unknown, or prior to Feb. 10, 1653, set to the NA value.
ORACLE:	FLOAT(53)
NA Value:	–9999999999.999 Allowed only in **stassoc**, all other relations require a valid time.
Units:	Seconds

Name:	*timedef*
Relation:	**assoc**
Description:	Time-defining code. This one character flag indicates whether the time of a phase is d (defining), or n (non-defining) for this arrival. See *azdef* and *slodef*.
ORACLE:	VARCHAR(1)
NA Value:	- (a dash)
Range:	{d | n}

Name:	*timeres*
Relation:	**assoc**
Description:	Time residual. This attribute is a travel time residual, measured in seconds. The residual is found by taking the observed arrival time (saved in the **arrival** relation) of a seismic phase and subtracting the expected arrival time. The expected arrival time is calculated by a formula based on earth velocity model (attribute *vmodel*), an event location and origin time (saved in table **origin**), the distance to the station (attribute *dist* in table **assoc**), and the particular seismic phase (attribute *phase* in table **assoc**).
ORACLE:	FLOAT(24)
NA Value:	–999.0
Units:	Seconds

Name:	*tshift*
Relation:	**sensor**
Description:	Correction for clock errors. This attribute is designed to accommodate discrepancies between actual time and the numerical time written by data recording systems. Actual time is the sum of the reported time plus *tshift*.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. An entry is required to define a valid record.
Units:	Seconds

Name:	*uncertainty*
Relation:	**netmag, stamag**
Description:	Magnitude uncertainty. This is the standard deviation of the accompanying magnitude measurement.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Range:	*uncertainty* > 0.0

Name:	*vang*
Relation:	**sitechan**
Description:	Vertical orientation of seismometer. This attribute 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*.
ORACLE:	FLOAT(24)
NA Value:	NOT ALLOWED. A valid entry is required.
Units:	Degrees
Range:	$0.0 \leq vang \leq 90.0$

Name:	*vmodel*
Relation:	**assoc**
Description:	Velocity model. This character string identifies the velocity model of the earth used to compute the travel times of seismic phases. These are required for event location (if phase is defining) or for computing travel-time residuals.
ORACLE:	VARCHAR(15)
NA Value:	- (a dash)
Range:	Any free-format string up to 15 characters

Name:	*volname*
Relation:	**wftape**
Description:	ANSI tape label. This gives the volume label information for a tape.
ORACLE:	VARCHAR(6)
NA Value:	- (a dash)
Range:	Any upper-case tape label up to 6 characters

Name:	*wfid*
Relations:	**wfdisc, wftag, wftape**
Description:	Waveform identifier. The key field is a unique identifier for a segment of digital waveform data.
ORACLE:	NUMBER(8)
NA Value:	NOT ALLOWED. A valid entry is required.
Range:	$wfid > 0$

Name:	*wgt*
Relation:	**assoc**
Description:	Location weight. This attribute gives the final weight assigned to the allied arrival by the location program. It is used primarily for location programs that adaptively weight data by their residuals.
ORACLE:	FLOAT(24)
NA Value:	–1.0
Range:	$0.0 \leq wgt < 1.0$