# 2
# GIS/Software structure

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This chapter describes the structure of the Geographic Information System (GIS) that governs the *Database of Potential Sources for Earthquakes Larger than M 5.5 in Italy*. In particular, section 2.1. provides a quick overlook of the entire software, of the relational structure, of the layer structure and of the main functions. The full detail on individual functions and on how to operate with them during a working session is given in section 3.2. Section 2.2. describes the complete architecture of the system, with a detailed description of the different table types and of the internal structure of the tables that are most likely to be updated or extended by individual future users of the *Database*.

## 2.1. Application overview

This section provides a quick overview of the *Database of Potential Sources for Earthquakes Larger than M 5.5 in Italy*. This overview is especially recommended for first-time users that want to learn quickly about the main features of the *Database* and the essential operating requirements.

### 2.1.1. Operations concept

The *Database of Potential Sources for Earthquakes Larger than M 5.5 in Italy* is a tool that enables geologists, geophysicists, earthquake and planning engineers to access detailed information about known Italian seismogenic sources, as well as a comprehensive set of background information, including administrative, geographical and earthquake data. The user is encouraged to refer to Chapter 1 for the definition of *seismic source* and of other conventional names used throughout this manual. The *Database* may also be used as a tool for civil defence purposes as it can generate first-level damage scenarios for an imaginary earthquake of given location and magnitude.

On startup the user is presented with a map of the main topographic features of Italy shown through a Digital Elevation Model (DEM). The map can be manipulated using some of the standard GIS tools (*e.g.*, zooming, panning, distance measurement, changing coordinate system, etc.). The user may superimpose on this basic map a set of layers which can be roughly classified into the three following categories:

- Seismic sources and tectonic lineaments;
- Background information;
- Scenarios.

The seismic sources have been categorised in several classes, according to the certainty and completeness of information available, ranging from *Historical-Poorly Constrained, no geological background* (least reliable) to *From Geologic/Geophysical data* (most reliable).

Best known sources are represented in three-dimensions as rectangular planes and are shown by the system as the projection of such planes onto the surface. The intersection of the plane representing the source with the topographic surface is shown for all sources with a straight line drawn next to the source projection. This is especially useful for indicating the dip direction of the plane in the case of sources with no surface expression associated with them (blind faults). In contrast, if surface breaks associated with the activity of the given source do exist, they are represented by an irregular pattern of short segments (depending on their actual complexity as described in literature) that may or may not lie next to intersection of the plane representing the source with the topography.

Least constrained sources are shown as circles whose diameter is a function of the presumable length of the source at seismogenic depth.

The system also stores and displays a large set of tectonic lineaments. These are roughly linear structures for which the tectonic origin is certain but the degree of present-day activity, and hence their role in the present-day geodynamics and their seismogenic potential, is as yet unknown.

By clicking on a source and selecting the appropriate menu items, the user may explore textual information which includes the geometric characteristics of the source, its dimensions and location, the historical seismic behaviour, summaries of the main studies by previous workers, a list of selected literature references and a set of comments and open questions. This set of data is complemented by images (drawings and photos) that bring additional information on each given source. The images can be original, that is, expressly prepared for the *Database*, or taken from published literature with permission from the copyright holders (when needed).

The background information is rather extensive and includes three realisations of a Digital Elevation Model of the Italian territory, three catalogues of historical earthquakes, two of which include felt intensity data, a catalogue of instrumental earthquakes, three levels of drainage, four classes of towns and villages, and three classes of administrative boundaries. It is also possible to access an extensive set of previous compilations of faults, which were georeferenced and can therefore be compared directly with all the material stored in the *Database*, and a set of tables containing other relevant geological, tectonic and geophysical information.

Among other functionalities of practical interest, a tool named "*Scenarios*" allows any concerned user (for example, a civil protection officer) to obtain a set of formalised estimates about the consequences of an earthquake of given location and size. For such an imaginary event the system supplies expected earthquake intensities both in map and report format. In particular, the intensities are derived according to a "best-case" and "worst-case" scenario, and are therefore presented as an expected intensity range for the given locality rather than as a single value. For the same imaginary event, or for a real one that just occurred, the system also supplies a full seismic characterisation of the epicentral area (including historical and instrumental events, neighbouring cities and villages, drainage and topography). The scenarios consist of maps that can be printed or exported in electronic form.

Finally, the *Database* is stored with a very simple structure as a set of tables in the MapInfo® GIS. As such, all datasets are available for easy inspection, verification, further processing and update. The architecture of the *Database* is extensively described in § 2.2.1. through 2.2.5., while the procedures and practical suggestions for looking into and updating the data tables are described in Chapter 3 and Chapter 4, respectively.

### 2.1.2. Application category

The *Database* is a MapInfo® application developed within the MapBasic® environment; as such, it is compiled in a neutral, proprietary format which can be executed on several platforms, including Microsoft Windows 9x/NT/2000 and MacOs. We did not test the *Database* on any other platform.

The application is standalone and access to data is essentially read-only. Therefore, multiple users in the same organisation must copy the database on any oher workstations as required.

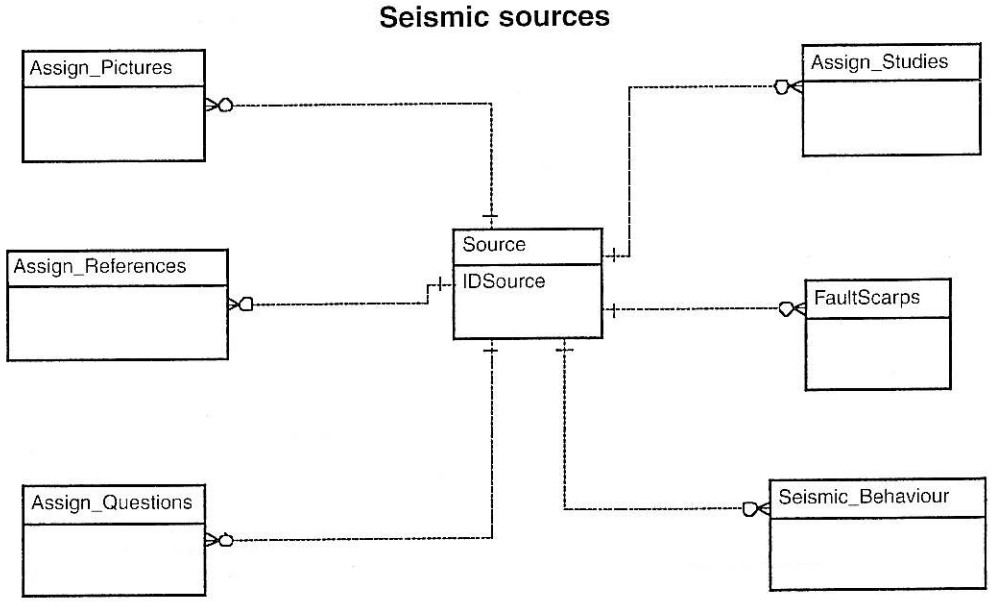
The *Database* is distributed on a single ISO 9660 CD, which may be accessed both by IBM compatible and Macintosh computers. It requires installation of a properly working copy of MapInfo® 4.0 or higher version; MapInfo® is not included in the distribution.

### 2.1.3. Relational structure

All data are stored in MapInfo® structures (tables); according to the content, they may be classified as *relational tables* and *raster tables*. *Relational tables* contain alphanumerical and geographical information; *raster tables* simply provide georeferencing for a bitmap (graphics data file). The total number of individual tables used by the system is over 650. In the rest of this section we discuss the Entity-Relationship model of the relational tables. Subsequent sections of the manual will describe relational and raster tables from a more application-oriented viewpoint.

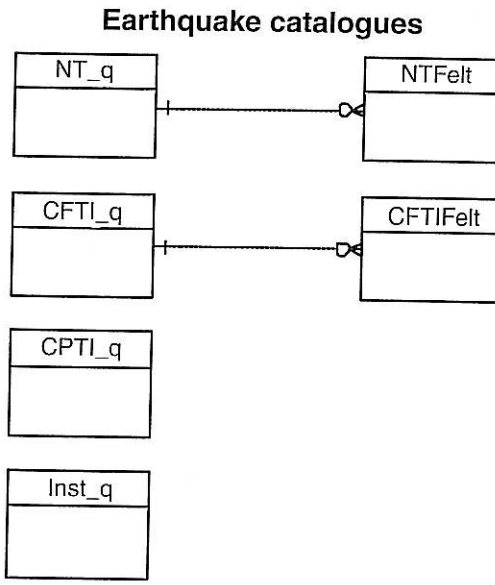
From a relational perspective, we decided to de-normalise several tables describing seismic sources, namely *SourceDeep, SourceGeol, SourceHistA, SourceHistARev, SourceHistB, SourceHistBRev* and *SourcePreferred*. However, all of those tables share a single object identity pool, and may therefore be considered as a single *Source* table in E-R diagrams.

The first E-R diagram shows the central role of the *Seismic Source* concept in the *Database*.

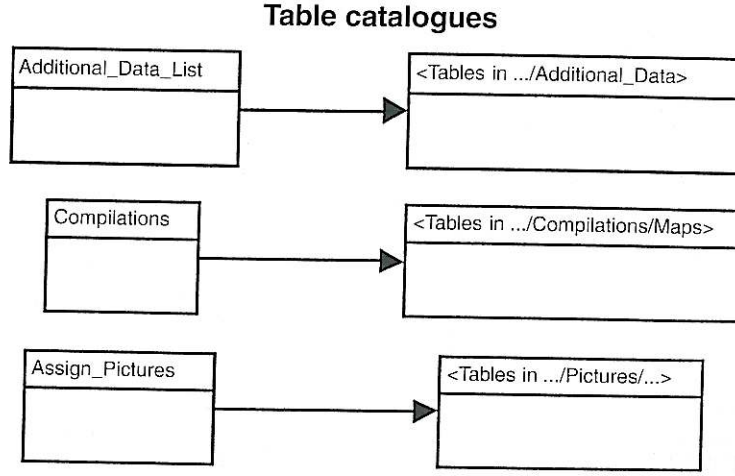



An essential piece of information contained in the *Database* is given by earthquake catalogues of historical and instrumental seismicity and by the individual intensity reports associated with historical events. The *Database* contains one instrumental catalogue (the INGV official catalogue, stored as **`Inst_q.tab`**: see § 2.2.5.2.1. for further details), plus three historical catalogues, whose acronyms are CFTI 3, NT 4.1.1 and CPTI (stored as **`CFTI_q.tab`, `NT_q.tab`, `CPTI_q.tab`**, respec-

tively: see § 2.2.5.2.2.). CFTI 3 and NT 4.1.1 have felt intensity reports associated with them, while CPTI and the INGV instrumental database have a flatter structure.




The rest of the database consist of flat tables, reflecting the co-existence of data coming from diverse sources that are integrated only by their geographic superposition. They lack any relational structure and are not presented here, although they will be discussed in detail in subsequent sections. However, there is a pattern of relationship among tables which is not reflected in the classic E-R theory, but deserves some explanation: it is formed by a table which is a catalogue of layers to be shown or hidden at the user's request. For each collection, only one layer of the collection is displayed at any one time; some additional data may also be available in alphanumeric form. The following figure documents the occurrences of this pattern.



### 2.1.4. Layer structure

The following table indicates the physical order in which layers are shown and provides a brief description for each layer. The user may refer to the following sections for a thorough explanation of structures and scopes.

| Name | Description |
|---|---|
| *Cosmetik* | Cosmetic layer (INGV logo, decorations, ...) |
| *Scale* | Scale |
| *FaultScarps* | Fault scarps |
| *SourcePreferred* | Seismogenic sources |
| *SourceGeol* | Seismogenic sources |
| *SourceHistA* | Seismogenic sources |
| *SourceHistARev* | Seismogenic sources |
| *SourceHistB* | Seismogenic sources |
| *SourceHistBRev* | Seismogenic sources |
| *SourceDeep* | Seismogenic sources |
| *GenericTectLineaments* | Tectonic lineaments |
| *TransverseTectLineaments* | Tectonic lineaments |
| *AdditionalData_Open* | Currently-open additional data |
| *Intensities* | Labels for intensities (earthquake catalogues with felt maps) |
| *Felt_Reports_Selected* | Additional info for felt reports |
| *Small_Localities* | Locality names |
| *Large_Cities* | Locality names |
| *Intermediate_Cities* | Locality names |
| *Small_Cities* | Locality names |
| *Instrumental_Quakes* | Instrumental earthquakes from the INGV catalogue |
| *Historical_Quakes_CFTI* | Historical earthquakes from CFTI 3 catalogue |
| *Historical_Quakes_CPTI* | Historical earthquakes from CPTI catalogue |
| *Historical_Quakes_NT* | Historical earthquakes from NT 4.1.1 catalogue |
| *ComuniBoundaries* | Administrative boundaries for the Italian "Comuni" |
| *Province* | Administrative boundaries for the Italian "Provincie" |
| *Borders* | Administrative boundaries for the Italian "Regioni" |
| *Grid_200, Grid_100, ...* | Grids at several spacings |
| *Main_Rivers* | Main rivers |
| *Lakes* | Main lakes |
| *Intermediate_Drainage* | Intermediate-scale drainage countrywide |
| *Idrvda, Idrpie, Idr** | Small-scale drainage for the Italian "Regioni" |
| *Compilation_Open* | Currently open fault compilation |
| *EuroMed* | Coastline for European-Mediterranean countries, except Italy |
| *EuroMed_Outline* | Coastline for European-Mediterranean countries and Italy |
| *Bat4000_BW, Bat*_BW* | Several layers of bathymetry in black and white |

| | |
|---|---|
| *Bat4000_CC, Bat*_CC* | Several layers of bathymetry, colour coded |
| *Ita1_CC, Ita2_CC, Ita*CC* | Tiles of the colour coded DEM |
| *Ita1_SR, Ita2_SR, Ita*SR* | Tiles of the shaded relief DEM |
| *Ita1_BW, Ita2_BW, Ita*CW* | Tiles of the black and white DEM |
| *Nothing* | Empty layer; used as a sentinel value |

### 2.1.5. Functions

The main function classes of the application have been grouped in seven broad categories, which are reflected in the application menus (File, View, Tools, Source Info, Lineament Info, Scenarios, Maintenance). The categories can be described as follows:

**a.** allows the user to print or save the currently open table or map, exit MapInfo® altogether, or close the DISS application, leaving open all the relevant tables. This feature allows for further elaboration of available data;

**b.** allows the user to show or hide some of the main available data layers; the application maintains a layer ordering which is meant to maximise data visibility;

**c.** makes the usual GIS operators available to the user and allows the standard operations of zooming, panning, distance measuring, selecting objects, selecting a new coordinate system, etc.;

**d.** gives access to relational information through a series of specifically designed dialog boxes when a *seismic source* has been selected;

**e.** gives access to a similar but smaller set of dialog boxes showing information about *tectonic lineaments*;

**f.** allows a concerned user (for example, a civil defence officer) to simulate earthquake intensities and estimate the earthquake impact on urban nuclei, obtaining reports both in tabular and geographic format;

**g.** allows a system engineer to perform maintenance operations to enter new or updated information in the *Database*.

## 2.2. ARCHITECTURE

This section describes how the *Database* is organised, how the different tables interact with each other to make it work, and the current content of its non-structural part (see description of table types in § 2.2.2.). To improve readability the text will make use of the following typing conventions all throughout:

- **`Courier Boldface`** will be used for all physical table and folder names;
- `Courier Plain Text` will be used for the name and format of the fields forming a table;
- *Times Italic* will be used for menu names and virtual table names;
- Times Plain Text will be used for all the rest, except for recurring names such as "*Database*" and for sentences that require special emphasis.

### 2.2.1. Directory structure

The directory structure of the software reflects as much as possible the categorisation of data in the user domain. The MapBasic® executable program, DISS.mbx, is located in the main directory of the product along with the three main subdirectories that contain all the *Database* information. The subdirectories contain the data layers, according to the following scheme:

| Directory name | Description |
|---|---|
| `Background_Info` | Support tables |
| `Background_Info/Administrative` | Administrative data |
| `Background_Info/DEM` | Digital elevation model |
| `Background_Info/DEM/Bathymetry` | Bathymetry of Mediterranean |
| `Background_Info/DEM/BW` | Black and white DEM |
| `Background_Info/DEM/ColourCoded` | Colour coded DEM |
| `Background_Info/DEM/ShadedRelief` | Shaded relief DEM |
| `Background_Info/Geographic` | Rivers, lakes, coastlines |
| `Background_Info/Geological` | Geological data |
| `Background_Info/Geological/Additional_Data` | Additional data (catalogue of) |
| `Background_Info/Geological/Compilations` | Fault compilations (catalogue of) |
| `Background_Info/Geological/Compilations/Maps` | Individual fault compilations |
| `Background_Info/Grids` | Geographic grid (variable spacing) |
| `Background_Info/Seismicity` | Earthquake catalogues |
| `Source_Data` | Specific information about sources |
| `Source_Literature` | Published info about specific sources |
| `Source_Literature/Open_Questions` | Comments and open questions |
| `Source_Literature/Pictures` | Pictures about faults |
| `Source_Literature/Previous_Studies` | Summaries of previous studies |

## 2.2.2. Table types

The *Database* contains three main categories of tables:

Structural tables contain the core of the *Database*, that is, the seismogenic sources. They include the geographic representation of each source along with all the related alphanumeric information. The structure and the content of these tables are illustrated in § 2.2.3.

Instrumental tables are used to relate each source to all the information available on it, such as references, pictures and text summaries. The structure and the content of these tables are illustrated in § 2.2.4.

Support tables contain several types of data to support the consultation of the *Database* and help placing the seismogenic sources in their actual seismological, geographic and administrative context. Support tables may be *source-specific*, *source-generic*, or *generic*. The structure and the content of these tables are illustrated in § 2.2.5.

| Table type | Located in folder | Described in |
|---|---|---|
| Structural Tables | `Source_Data` | § 2.2.3. |
| Instrumental Tables | `Source_Data` | § 2.2.4. |
| Support Tables: | | |
| • *Source-specific* | `Source_Literature` | § 2.2.5.1. |
| • *Source-generic* | `BackGround_Info` > `Geological` | § 2.2.5.2. |
| • *Generic* | `BackGround_Info` > (all others) | § 2.2.5.3. |

All tables have: 1) a standard or virtual name that refers to their actual content and to the corresponding menu item; 2) a physical name used to identify the relevant file(s) in the disk database. The menu item name was selected to allow easy identification of the scope and information content of a specific table and is normally formed by a sequence of words in "title case" (all initials are written in uppercase, *e.g.*: *Seismogenic Sources from Geologic/Geophysical Data*). The physical table filename uses the same keywords in a condensed form and with optional underscore ("_") symbols in place of blank spaces (*e.g.*, *Seismogenic Sources from Geologic/Geophysical Data* > **`SourceGeol.tab`**). All filenames are subject to restrictions imposed by MapInfo® and were selected following the naming conventions of Apple OS and Windows 95 and higher.

In the following section we will describe the general structure of all the tables used by the *Database*. A detailed description of the internal structure and of individual data fields is supplied for those tables that can be more easily updated or extended by the user. The internal structure of each table can also be explored directly using MapInfo® through the menu sequence *Table* > *Maintenance* > *Table Structure*.

### 2.2.3. Structural tables

All the seismogenic sources contained in the *Database* are organised in six main categories, depending on how they were derived and on the overall reliability of their identification and characterisation:

- *From Geologic/Geophysical Data*;
- *Historical - Well Constrained with Geological Background*;
- *Historical - Well Constrained, no Geological Background*;
- *Historical - Poorly Constrained with Geological Background*;
- *Historical - Poorly Constrained, no Geological Background*;
- *Deep*.

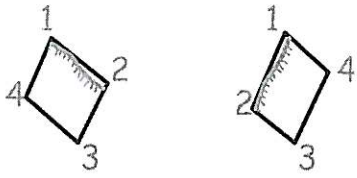
An additional category is the *Integrated Source Dataset*. This is an important set that includes the "preferred" parameters for those sources for which more than one solution is available *(e.g.*, the source of large recent earthquake for which both geologic/geophysical and historical information is available).

All sources have one or more "compilers"; see Appendix I for a complete list of sources and corresponding compilers.

#### 2.2.3.1. Seismogenic sources - from geologic/geophysical data

This category stores data on seismogenic sources for which either geological or geophysical evidence is available and that received special attention during the compilation of the *Database*. For all sources of this group the compiler has brought together geological, seismological and other geophysical information (essentially references and pictures) and has prepared *Summaries of the Main Studies on the Source* and *Comments and Open Questions* files. The name of the associated physical table is **`SourceGeol.tab`**.

**Table structure: `SourceGeol.tab`**

| Field name | Content | Format |
|---|---|---|
| `SourceName` | Encodes the source by a name | `Char(50)` |
| `IDSource` | Encodes the source by an identification number. Ranges between 1-200 for *Geologic/Geophysical* sources | `Integer` |
| `Quality` | Reliability of source data. See text for details | `Char(1)` |
| `lat1`<br>`lon1`<br>`lat2`<br>`lon2`<br>`lat3`<br>`lon3`<br>`lat4`<br>`lon4` | Geographic coordinates of the corners of the box representing the surface projection of the source. The corners are numbered conventionally starting from the northernmost upper one and moving in the clockwise or anti-clockwise direction respectively for a W- or E-dipping plane. Note that corners 1 and 2 are always associated with the upper edge of the box   | `Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)` |
| `Length` | Length of segment joining the two uppermost tips of the fault plane (km) | `Char(8)` |
| `Width` | Down-dip width of the fault plane, that is, the length of the segment traced between the top and the bottom of the fault plane (km) | `Char(4)` |
| `Strike` | Strike is measured in degrees clockwise with respect to the north using the following convention: E-dipping planes strike between 270° and 90°; W-dipping planes strike between 90° and 270° | `Char(10)` |
| `Dip` | Angle between the fault plane and the horizontal (degrees) | `Char(4)` |
| `Rake` | Expresses the sense of motion of the hanging-wall with respect to the foot-wall and is measured counterclockwise (degrees) starting from the horizontal. The rake of a pure normal, reverse, left-lateral and right-lateral fault is 270°, 90°, 0° and 180°, respectively | `Char(4)` |
| `Min_Depth` | Min depth of fault plane from topographic surface (km) | `Char(8)` |
| `Max_Depth` | Max depth of fault plane from topographic surface (km) | `Char(8)` |
| `Evidence` | Type of evidence used to identify the source | `Char(254)` |
| `latN`<br>`lonN`<br>`latS`<br>`lonS` | Coordinates of northern and southern tips of:<br>• the intersection between the fault plane and the topographic surface for surface-breaking faults<br>• the intersection between the projection of the fault plane and the topographic surface for blind faults | `Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)` |
| `Compiled_by` | Name(s) of the compiler(s) of the given source | `Char(50)` |
| `Preferred` | Logical variable which assumes the value T or F (true/false) to state if the source should or should not be added to the *Integrated Source Dataset* | `Logical` |

Notice that the *minimum depth of the fault plane from topographic surface* is to be intended as the depth of the seismogenic portion of the source. To avoid ambiguities and potential modelling problems, the minimum value for this parameter was conventionally set at 1 km. The underlying assumption is that the shallowest 1 km of crust above a seismogenic source may only react passively to slip on the underlying fault even if sizeable surface faulting may occur.

The rating of sources of this category through the field `Quality` is based on expert judgement by the compiler of each individual source. The process is very complex because of the large number

and the diverse nature of uncertainty types involved in the identification and characterisation of any individual source. For example, some of the sources carry an epistemic uncertainty associated with their mere existence, or with their attitude towards generating their maximum-size earthquake *versus* releasing multiple smaller events. These types of non-conventional uncertainties are difficult to be incorporated into a single rating parameter and for the time being this task has been entirely left to the expert judgement of the individual compilers.

The following is a simplified scheme that was followed for rating all *Geologic/Geophysical* sources. Notice that additional information on the reliability of the proposed source parameters is generally contained in the *Comments and Open Questions* text associated with most sources.

**Rating criteria:** ***Geologic/Geophysical sources***

| Rating | Description |
|---|---|
| A | Class A is assigned to all sources for which there exists combined instrumental, historical and geologic/geomorphic evidence. The source parameters of Class A sources are constrained by seismological or geodetic evidence that allow a finer resolution than that granted by surface geology data alone. |
| B | Class B is assigned to all sources for which there exists satisfactory historical/paleoseismological and geologic/geomorphic evidence. Class B typically includes the source of earthquakes that occurred in the pre-instrumental era. The source parameterisation is jointly constrained by the extent of the historical rupture and by the occurrence of significant geologic features such as the size and extent of a basin, the intersection with known tectonic lineaments, the rupture terminations of Class A sources and other possible geological boundaries. |
| C | Class C is assigned to all sources that were derived from geologic/geomorphic evidence but for which limited or no historical evidence exists, or that possess satisfactory historical but limited/debatable geologic/geomorphic evidence. The source must be on-land and associated with clearly identified large-scale features belonging to known regional trends. This class and the following Class D also include sources for which there is epistemic uncertainty as to their existence as active features and to their potential as seismogenic sources. |
| D | Similarly to Class C, Class D is assigned to all sources that were derived from geologic/geomorphic evidence with limited or no historical constraints. Unlike the previous class, the source may be offshore and its location constrained only by reflection seismology data or other large-scale observations used to pinpoint regional trends of homogeneous tectonic deformation. |

### 2.2.3.2. Seismogenic sources - historical - well constrained with geological background

Includes all seismogenic sources derived exclusively from intensity data following the method proposed by Gasperini *et al.* (1999) and for which the quality of the solution obtained was good enough to allow the representation by an oriented rectangular box (see fig. 1 and relevant text in Gasperini *et al.*, 1999). For sources of this group the compiler has brought together support information (essentially references and pictures) and has prepared *Summaries of the Main Studies on the Source* and *Comments and Open Questions* files, similarly to what is done for all *Sources from Geologic/Geophysical Data*. The additional information, however, was not enough to allow the compiler to turn this source into a *Geologic/Geophysical Source*.

The name of the associated physical table is **`SourceHistARev.tab`**, where

- *Hist* indicates that the source was derived from intensity data exclusively;
- *A* indicates that sources of this type are of better quality among all those obtained from intensity data;
- *Rev* indicates that there has been a revision by the compiler.

**Table structure: `SourceHistARev.tab`, `SourceHistA.tab`**

| Field name | Content | Format |
|---|---|---|
| `SourceName` | Encodes the source by a name | `Char(50)` |
| `IDSource` | Encodes the source by an identification number. Ranges between 201-400 and 401-500 for sources without or with *Geological Background*, respectively | `Integer` |
| `Quality` | Reliability of source data expressed through two distinct parameters. See text for details | `Char(3)` |
| `lat1`<br>`lon1`<br>`lat2`<br>`lon2`<br>`lat3`<br>`lon3`<br>`lat4`<br>`lon4` | Geographic coordinates of the corners of the box representative of the source. The corners and the associated distances (length, width) are provided directly by the method proposed by Gasperini *et al.* (1999) | `Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)`<br>`Char(8)` |
| `Length` | Length of segment joining the two uppermost corners of the fault plane (km) | `Char(8)` |
| `Width` | Length of segment corresponding to a short side of the fault plane (km) | `Char(4)` |
| `Strike` | Strike is measured in degrees clockwise with respect to the north. Given the lack of information about the direction of dip of the fault, any strike value is equivalent to strike + 180°. The uncertainty is supplied directly by the method proposed by Gasperini *et al.* (1999) | `Char(10)` |
| `Evidence` | Type of evidence used to identify the source | `Char(254)` |
| `Compiled_by` | Name(s) of the compiler(s) of the given source | `Char(50)` |
| `Preferred` | Logical variable which assumes the value T or F (true/false) to state if the source should or should not be added to the *Integrated Source Dataset* | `Logical` |

Notice that the structure of this table differs from that of **`SourceGeol.tab`** for the following reasons:

- lack of fields `Dip`, `Rake`, `Min_Depth` and `Max_Depth`, all of which cannot be assessed using the procedure of analysis of intensity data proposed by Gasperini *et al.* (1999);
- lack of fields describing the location of the surface expression of the source;
- more quantitative definition of `Quality` (two distinct parameters);
- uncertainty in the definition of `Strike`.

The field `Quality` contains two distinct parameters (*Q1*, *Q2*) for assessing the uncertainties associated with the given source model. These parameters where assigned based on the results of the method proposed by Gasperini *et al.* (1999). In particular, *Q1* is based on the uncertainty associated

**Rating criteria: all *Historical Sources***

| Q1 | Orientation uncertainty | Q2 | Number of intensity data |
|---|---|---|---|
| A | < 10° | A | > 500 |
| B | 10°-24° | B | 100-499 |
| C | 25°-49° | C | 50-99 |
| D | ≥ 50° | D | 20-49 |
| E | no orientation assessed | E | < 20 |

with the definition of the source azimuth, while *Q2* reflects the global number of intensity data available for the given source. Notice that this rating applies also to sources of the categories *Historical - Poorly Constrained* and *Deep* (*e.g.*, rating "E" for *Q1*).

#### 2.2.3.3. Seismogenic sources - historical - well constrained, no geological background

Includes all seismogenic sources derived exclusively from intensity data following the method proposed by Gasperini *et al.* (1999) and for which the quality of the solution obtained was good enough to allow the representation by an oriented rectangular box (see fig. 1 and relevant text in Gasperini *et al.*, 1999). For these sources, however, no additional information is supplied by the compiler. The name of the associated physical table is **`SourceHistA.tab`**. The structure of the table is the same as for **`SourceHistARev.tab`**.

#### 2.2.3.4. Seismogenic sources - historical - poorly constrained with geological background

Includes all seismogenic sources derived exclusively from intensity data following the method proposed by Gasperini *et al.* (1999) and for which the quality of the solution obtained was not good enough to allow the representation by an oriented rectangular box (see fig. 1 and relevant text in Gasperini *et al.*, 1999). The source was then represented as a circle having the diameter equal to the estimated source length. For sources of this group the compiler has brought together support information (essentially references and pictures) and has prepared *Summaries of the Main Studies on the Source* and *Comments and Open Questions* files, similarly to what is done for the *Geologic/ Geophysical Sources*. The additional information, however, was not enough to allow the compiler to turn this source into a *Geologic/Geophysical Source*.

The name of the associated physical table is **`SourceHistBRev.tab`**, where

- *Hist* indicates that the source was derived from intensity data exclusively;
- *B* indicates that sources of this type are of lesser quality among all those obtained from intensity data;
- *Rev* indicates that there has been a revision by the compiler.

**Table structure: `SourceHistBRev.tab`, `SourceHistB.tab`**

| Field name | Content | Format |
|---|---|---|
| `SourceName` | Encodes the source by a name | `Char(50)` |
| `IDSource` | Encodes the source by an identification number. Ranges between 501-800 and 801-900 for sources without or with *Geological Background*, respectively | `Integer` |
| `Quality` | Reliability of source data expressed through two distinct parameters. See text for details | `Char(3)` |
| `lat`<br>`lon` | Centre of the circle representative of the source. The source radius is provided directly by the method proposed by Gasperini *et al.* (1999) | `Char(8)`<br>`Char(8)` |
| `Radius` | Radius of given source (km). This value equals the estimated half length. | `Char(8)` |
| `Evidence` | Type of evidence used to identify the source | `Char(254)` |
| `Compiled_by` | Name(s) of the compiler(s) of the given source | `Char(50)` |
| `Preferred` | Logical variable which assumes the value T or F (true/false) to state if the source should or should not be added to the *Integrated Source Dataset* | `Logical` |

Notice that the structure of this table differs from that of **SourceHistARev.tab/ SourceHistA.tab** for the following reasons:

- lack of fields Strike, Length, Width due to lesser quality of solution;
- use of Radius to characterise the size of the source.

For similarity with sources of the category *Historical - Well Constrained*, the field Quality contains two distinct parameters for assessing the uncertainties associated with the given source model. Notice that *Q1* is always equal "E". See scheme at the end of § 2.2.3.2. for further details.

### 2.2.3.5. Seismogenic sources - historical - poorly constrained, no geological background

Includes all seismogenic sources derived exclusively from intensity data following the method proposed by Gasperini *et al.* (1999) and for which the quality of the solution obtained was not good enough to allow the representation by an oriented rectangular box (see fig. 1 and relevant text in Gasperini *et al.*, 1999). For these sources, however, no additional information is supplied by the compiler. The name of the associated physical table is **SourceHistB.tab**. The structure of the table is the same as for **SourceHistBRev.tab**.

### 2.2.3.6. Seismogenic sources - Deep

Includes sources derived exclusively from intensity data following the method proposed by Gasperini *et al.* (1999) and for which the compiler hypothesised a depth larger than ordinary (usually below 10 km). The assignment of a source to this category is irrespective of whether the formal uncertainties in the solution obtained would have allowed to derive a rectangular source or simply a circular source. Notice that in the case of a source deeper than usual the technique proposed by Gasperini *et al.* (1999) would not be able to derive correctly the true elongation of the source, and any asymmetries in the intensity pattern could more likely result from propagation effects.

The name of the associated physical table is **SourceDeep.tab**. To allow a better visual separation, sources of this category are drawn using hexagons.

**Table structure: SourceDeep.tab**

| Field name | Content | Format |
|---|---|---|
| SourceName | Encodes the source by a name | Char(50) |
| IDSource | Encodes the source by an identification number. Ranges between 901-1000 | Integer |
| Quality | Reliability of source data expressed through two distinct parameters. See text for details | Char(3) |
| lat<br>lon | Centre of the hexagon representative of the source. The source radius is provided directly by the method proposed by Gasperini *et al.* (1999) | Char(8)<br>Char(8) |
| Radius | Radius of given source (km). This value equals the estimated half length. | Char(8) |
| Evidence<br>Compiled_by | Type of evidence used to identify the source<br>Name(s) of the compiler(s) of the given source | Char(254)<br>Char(50) |
| Preferred | Logical variable which assumes the value T or F (true/false) to state if the source should or should not be added to the *Integrated Source Dataset* | Logical |

Notice that the structure of this table is nearly identical to that of **SourceHistBRev.tab/ SourceHistB.tab**.

The field `Quality` contains two distinct parameters for assessing the uncertainties associated with the given source model. The assessment is done following the scheme used for sources of the category *Historical - Poorly Constrained*. Notice that *Q1* is always equal "E". See scheme at the end of § 2.2.3.2. for further details.

### 2.2.3.7. Integrated source dataset

The structure of the *Database* allows for multiple solutions for the same physical seismogenic source. For example, a source of the category *Historical - Well Constrained* will always have also the corresponding solution in the category *Historical - Poorly Constrained* and possibly also in the *Geologic/Geophysical*. The *Integrated Source Dataset* (**`SourcePreferred.tab`**) displays the «preferred» set of sources, that is to say, in case of multiple solutions the compiler has made a decision concerning which source should be used for further elaborations. The decision is made by setting the logical variable in the field *Preferred* to "*T*" or "*F*" depending on whether the compiler wants the specific source to be included or not included in the *Integrated Source Dataset*. Notice that this field appears in all primary structural tables described in § 2.2.3. The *Integrated Source Dataset* is generated by the *Database* itself during the *Maintenance* operations (see § 4.5.).

### 2.2.3.8. Seismic behaviour

The table **`Seismic_Behaviour.tab`** stores parameters used to characterise the behaviour of each seismogenic source for all source categories. The table contains data selected or re-interpreted

**Table structure: `Seismic_Behaviour.tab`**

| Field name | Content | Format |
|---|---|---|
| `SourceName` | Encodes the source by a name | `Char(50)` |
| `IDSource` | Encodes the source by an identification number | `Integer` |
| `Last Earthquake` | Date of most recent earthquake rupturing the entire length of the given seismogenic source | `Char(150)` |
| `Prev Max Earthquake` | List age of any previous maximum earthquakes identified from paleoseismological, geologic and historical evidence | `Char(254)` |
| `Recurrence Interval` | Average time span between two subsequent maximum events generated by the same source, expressed in years | `Char(150)` |
| `Elapsed Time` | Time elapsed since `Last Earthquake`, in years, conventionally referred to the year 2000 | `Char(60)` |
| `Slip Rate` | Slip-rate in mm/year, either published or estimated by the compiler based on original or published data. In either case, the section *Comments and Open Questions* should be used to explain how the slip-rate was estimated/computed | `Char(254)` |
| `Average Displacement` | Average coseismic displacement, in meters | `Char(100)` |
| `Expected Magnitude` | For *Geologic/Geophysical* sources: magnitude calculated from source size through empirical relations.<br>For *Historical* sources: magnitude of historical earthquake (corresponding with magnitude used to assess source length and width) | `Char(100)` |

from published literature. If the information available is too complicated or controversial to be expressed by a number, the compiler fills-in the corresponding field with an asterisk and explains the matter in the *Comments and Open Questions*.

### 2.2.3.9. Fault scarps

The table **FaultScarps.tab** lists genuinely tectonic surface ruptures that are thought to slip in conjunction with one or more sources of the *Geologic/Geophysical* category. The ruptures are usually more than one and include primary ruptures located along the fault projection onto the surface and secondary ruptures located within the surface projection (*e.g.*, in the hanging-wall compartment of a normal fault). Each rupture is identified by an `IDScarp` code and is logically linked to one or more individual sources through the `IDSource` code. However, this does not preclude that it may move as a result of the activation of other sources. Each rupture is characterised also by a name and bibliography references.

Notice that in the *Database* a surface rupture is intended as a strictly graphical object that is not described by geographic coordinates. This is due to the fact that some surface ruptures have a complex trend that may easily be described as a complex graphical object by the cartographic interface but that would be complicated to describe as a sequence of latitude-longitude pairs. The coordinates of each point of a given surface rupture can obviously be inferred from the cartographic interface using the standard tools of MapInfo®.

**Table structure: `FaultScarps.tab`**

| Field name | Content | Format |
|---|---|---|
| `IDSource` | Links the surface rupture with a seismogenic source | `Integer` |
| `IDScarp` | Encodes the rupture by a number. Further ruptures associated with the same source must have a different code | `Integer` |
| `SourceName` | Name of the source to which the surface rupture is linked | `Char(32)` |
| `FaultScarp-Name` | Encodes the surface rupture by a name | `Char(60)` |
| `Reference` | Reference(s) for the given surface rupture | `Char(60)` |

### 2.2.3.10. Tectonic lineaments

The tables **TransverseTectLineaments.tab** and **GenericTectLineaments.tab** contain linear tectonic features taken from published literature. The first table contains lineaments that lie nearly perpendicular to the general trend of the main seismogenic sources, while all the remaining lineaments are included in the second table. These two subsets are prepared by the *Database* itself during the *Maintenance* operations starting from **Tectonic_Lineaments.tab** (see § 4.5.). Each lineament may be mapped as a single line or as a segmented element, depending on how it was originally drawn in the referenced paper(s). The *Tectonic Lineaments* may or may not be active or seismogenic; under special circumstances, limited portions of them may be identified as *Geologic/Geophysical* sources and treated accordingly. Similarly to the seismogenic sources, each *Tectonic Lineament* may be assigned one or more references (see § 2.2.4.4.).

**Table structure: `Tectonic_Lineaments.tab`**

| Field name | Content | Format |
|---|---|---|
| `Name` | Encodes the tectonic lineament by the name with which it is identified in the referenced paper(s) | `Char(50)` |
| `ID` | Encodes the tectonic lineament by an identification number | `Integer` |
| `Type` | Describes the type of lineament as "G" (Generic) or "T" (Transverse) | `Char(1)` |
| `Reliability` | Rates the reliability of the given tectonic lineament on a scale of A (most reliable) to D (least reliable) | `Char(16)` |
| `Evidence` | Type of evidence available in literature to identify the given tectonic lineament | `Char(80)` |
| `Notes` | Describes the general geometry, kinematics and timing of the given tectonic lineament, with specific reference to the investigators that supplied the information | `Char(250)` |

### 2.2.3.11. Summary of structural tables

The following scheme summarises the correspondence between standard and virtual names for all of the Structural Tables. "Corresponding file(s)" specifies the location of the tables within the disk database. The specification "Layer" indicates that the given table is also a layer of the Geographic Information System, that is, has graphic objects associated with it. These are drawn as specified in "Symbol" and with the colour specified in "Colour".

| Table name/Menu item | Corresponding file(s) | Layer | Symbol | Colour |
|---|---|---|---|---|
| *Seismogenic Sources from Geologic/Geophysical Data* | **`SourceGeol.tab`** **`FaultScarps.tab`** | Y | Box | Orange Red |
| *Seismogenic Sources - Historical - Well Constrained with Geological Background* | **`SourceHistARev.tab`** | Y | Box | Blue |
| *Seismogenic Sources - Historical - Well Constrained, no Geological Background* | **`SourceHistA.tab`** | Y | Box | Black |
| *Seismogenic Sources - Historical - Poorly Constrained with Geological Background* | **`SourceHistBRev.tab`** | Y | Circle | Blue |
| *Seismogenic Sources - Historical - Poorly Constrained, no Geological Background* | **`SourceHistB.tab`** | Y | Circle | Black |
| *Seismogenic Sources - Deep* | **`SourceDeep.tab`** | Y | Hexagon | Violet |
| *Integrated Source Dataset* | **`SourcePreferred.tab`** | Y | All of above | All of above |
| *Seismic Behaviour* | **`Seismic_Behaviour.tab`** | N | ------- | ------- |
| *Tectonic Lineaments* | **`Tectonic_Lineaments.tab`** | N | ------- | ------- |
| *Generic Tectonic Lineaments* | **`GenericTectLineaments.tab`** | Y | Line | Yellow |
| *Transverse Tectonic Lineaments* | **`TransverseTectLineaments.tab`** | Y | Line | Yellow |

## 2.2.4. Instrumental tables

These tables create logical links between each individual source and the information concerning it currently available in the *Database*. In particular these tables are used to assign to each source:
- the *Summaries of the Main Studies* text file;
- the *Comments and Open Questions* text file;
- all the available images or photographs, either published or original;
- all the available references.

### 2.2.4.1. Assign studies

The table **`Assign_Studies.tab`** links each *Summaries of the Main Studies on the Source* text file with the seismogenic source to which it refers.

**Table structure: `Assign_Studies.tab`**

| Field name | Content | Format |
|---|---|---|
| `IDSource` | Encodes the source by an identification number | `Integer` |
| `filename` | Name of the file containing the *Summaries of the Main Studies* for the given source | `Char(32)` |

### 2.2.4.2. Assign questions

The table **`Assign_Questions.tab`** links the *Comments and Open Questions* text file with the seismogenic source to which it refers.

**Table structure: `Assign_Questions.tab`**

| Field name | Content | Format |
|---|---|---|
| `IDSource` | Encodes the source by an identification number | `Integer` |
| `filename` | Name of the file containing the *Comments and Open Questions* for the given source | `Char(32)` |

### 2.2.4.3. Assign pictures

The table **`Assign_Pictures.tab`** stores data on images or photographs associated with a given source. More specifically, the table links each source with the titles and file names of the relevant pictures and of the associated captions.

**Table structure: `Assign_Pictures.tab`**

| Field name | Content | Format |
|---|---|---|
| `IDSource` | Links the picture to a source by its identification number | `Integer` |
| `Title` | Title of the picture as it will appear in the *Pictures* dialog box. The same title cannot be assigned to more than one picture within the same source | `Char(50)` |
| `Picture` | Name of the relational table associated with the raster file containing the picture | `Char(32)` |
| `Caption` | Name of the table containing the caption for the corresponding picture | `Char(32)` |

### 2.2.4.4. Assign references

The table **`Assign_References.tab`** lists in full detail all the references contained in the *Database* and links each of them to the seismogenic source or tectonic lineament to which it refers. More specifically, the table contains references:

- that were used to prepare the *Summaries of the Main Studies on the Source* and *Comments and Open Questions* text files for a given source;
- that were used to derive the source parameters;
- that contain general information on the geology, geomorphology, and seismicity of the source areas but are not directly used as a source of information;
- that describe one or more tectonic lineaments supplying their location, name and characteristics.

A flag creates a link between each of the source parameters and the reference from which the given parameter was derived. Notice that this piece of information is optional: the default is "Compilers of this Database".

**Table structure: `Assign_References.tab`**

| Field name | Content | Format |
|---|---|---|
| `IDSource` | Links to the relevant source or tectonic lineament by its identification number | `Integer` |
| `Authors` | Authors of given reference (see table for adopted format) | `Char(249)` |
| `Year` | Year of publication | `Char(10)` |
| `Title` | Full title of reference (see table for adopted format) | `Char(254)` |
| `Reference` | Full reference of journal, proceedings volume or book were the given paper was published. Journal titles should be abbreviated according to the World List of Abbreviations followed by volume number, first and last page (see table for adopted format) | `Char(254)` |
| `Code_Year` | Internal code (same as Year of publication) | `Char(4)` |
| `Code_Language` | Reference language: I = Italian, E = English, O = Other | `Char(1)` |
| `Code_Publication` | Reference type: A, B, J, M, P, V, W respectively for: Abstract, Book, Journal, Manuscript, Proceedings, Volume, Website (see § 2.2.4.4.2. for details) | `Char(1)` |
| `Code_ReferenceID` | Identification number of given reference within the *Database* printed paper files (see § 2.2.4.4.1. for details) | `Char(4)` |
| `Availability` | Y if paper is available in the *Database* printed paper files, otherwise N | `Char(1)` |
| `TpLength`<br>`TpWidth` | Reference contains information on the length and width of the source (T or F) | `Logical`<br>`Logical` |
| `TpStrike`<br>`TpDip`<br>`TpRake` | Reference contains information on the strike, dip, and rake of the source (T or F) | `Logical`<br>`Logical`<br>`Logical` |
| `TpMinDepth`<br>`TpMaxDepth` | Reference contains information on the min, max depth of given source (T or F) | `Logical`<br>`Logical` |
| `TpLastEq`<br>`TpMaxEq` | Reference contains information on the most recent earthquake and on the previous earthquake(s) generated by given source (T or F) | `Logical`<br>`Logical` |
| `TpRecInt`<br>`TpElapTime` | Reference contains information on the recurrence interval and elapsed time for the given source (T or F) | `Logical`<br>`Logical` |

| | | |
|---|---|---|
| `TpSlipRate`<br>`TpAvDisp` | Reference contains information on the slip rate and average displacement for the given source (T or F) | `Logical`<br>`Logical` |
| `TpExpMagn` | Reference contains information on the magnitude of the largest earthquake expected to be generated by the given source (T or F) | `Logical` |

2.2.4.4.1. Assigning a new *Code Reference*

Any new reference is uniquely identified through the `Code_ReferenceID`, which is the code assigned to the given article, map, book or manuscript within the physical database of printed papers available at Istituto Nazionale di Geofisica e Vulcanologia in Rome. As explained in the chapter on *Updating the Database* (§ 4.1.4.), it is suggested that the references table be handled through a Microsoft® Excel twin copy of **`Assign_References.tab`**. This allows an easier check of the existing codes and a safer assignment of a new one, which can simply be the next available four-digit number. This number will appear printed on the paper stored in the physical database.

2.2.4.4.2. Filling-in the *Code Publication* field

This field is used to specify the type of publication that corresponds to each specific reference. Along with the `Code_Language` specifier, this field helps determining the characteristics of the papers that were used as a source of data for the compilation of the *Database*. The `Code_ReferenceID` and `Availability` specifiers help retrieving the publication of interest from the physical database of printed papers available at Istituto Nazionale di Geofisica e Vulcanologia in Rome.

*Abstracts* Includes all abstracts and posters presented at meetings or conferences regardless of whether the same material has subsequently been published on proceedings or on a journal.

*Books* Includes all books that are intended for commercial distribution and can be freely purchased from the publisher.

*Journal* Includes all articles that appear on peer-reviewed, regularly published journals, either national or international.

*Manuscript* Includes theses, internal reports and all other material that has not appeared in publication as such, which was not intended for distribution and that can only be obtained directly from the author.

*Proceedings* Includes conference proceedings that are part of a regular series of publications.

*Volume* Includes all publications that do not fall in any of the previous categories, *e.g.*, conference proceedings that have been collected by one or more editors and are not part of a regular series, special celebration volumes, contributions to projects (only if available to the general public; otherwise they should be categorised as Manuscripts).

*Website* Indicates that the information was obtained from a World Wide Web site, regardless of whether the content of the site has been or will be published in any other form.

### 2.2.4.5. Summary of instrumental tables

The following scheme summarises the correspondence between standard and virtual names for all of the *Instrumental Tables*, along with their links to folders and subfolders of the disk database.

| Table name/Menu item | Corresponding disk file(s) | Links to |
|---|---|---|
| *Assign Studies* | **Assign_Studies.tab** | Source_Literature folder<br>Previous_Studies subfolder |
| *Assign Questions* | **Assign_Questions.tab** | Source_Literature folder<br>Open_Questions subfolder |
| *Assign Pictures* | **Assign_Pictures.tab** | Source_Literature folder<br>Pictures subfolder<br>F* sub-subfolder |
| *Assign References* | **Assign_References.tab** | Physical database of printed papers at INGV, Rome |

### 2.2.5. Support tables

These tables contain information that supports many representation and operating functions. They are all accessed through the menu *View*. The support information may be *Source Specific*, *Source Generic*, or *Generic*. Most of the information is public domain or was derived from published datasets. The following description is organised based on these three categories of *Support Tables*.

#### 2.2.5.1. Source specific support tables

These tables contain information that relates specifically to one of the sources. Notice that this type of information is available only for sources that belong to the *Geologic/Geophysical*, *Historical - Well Constrained with Geological Background* and *Historical - Poorly Constrained with Geological Background* categories, with the sole exception of the *References*.

The following scheme summarises the correspondence between standard and virtual names for all of the *Source Specific Support Tables*. "Corresponding file(s)" specifies the location of the tables within the disk database.

| Table name/menu item | Corresponding file(s) | Content |
|---|---|---|
| *Summaries of the Main Studies on the Source* | **Source_Literature** folder<br>**Previous_Studies** subfolder<br>**S-ITA-*.txt** | Summaries of papers (in chronological order) describing the source and its geologic and tectonic environment |
| *Comments and Open Questions* | **Source_Literature** folder<br>**Open_Questions** subfolder<br>**Q-ITA-*.txt** | Summary of the compiler's comments and of aspects of the source that still need to be investigated/understood |
| *Pictures* | **Source_Literature** folder<br>**Pictures** subfolder<br>**F*** sub-subfolder<br>**F*_*.tab**<br>**F*_*_CAP.tab** | Published (scanned) or original pictures or photographs describing the source and its tectonic environment, and their caption containing a full reference to the source of the image |
| *References* | **Source_Data** folder<br>**Assign_References.tab** | References contained in the *Database* |

See also § 4.1.2. for a description of the main characteristics of the *Summaries of the Main Studies on the Source* and *Comments and Open Questions* text files, § 4.1.3. for a description of how to select *Pictures*, § 2.2.4.4. and 4.1.4. for guidelines concerning the *References*.

### 2.2.5.2. Source generic support tables

These tables contain information that relates indirectly to all the sources and that may be used to place them in their seismological, geologic and tectonic context.

The following scheme summarises the correspondence between standard and virtual names for all of the *Source Generic Support Tables*. By definition all these tables are also layers of the Geographic Information System. "Colour" specifies the colour used to represent the given graphic objects in the Geographic Information System; for scanned images this field is omitted. "Corresponding file(s)" specifies the location of the tables within the disk database; since all the support tables are located in the folder **`Background_Info`**, this information is omitted.

| Table name/menu item | Corresponding disk file(s) | Type | Colour |
|---|---|---|---|
| *Instrumental Earthquakes* | **`Seismicity/Inst_q.tab`** | Vector | B/W |
| *Historical Earthquakes:* | | | |
| • *from Catalogue of Strong Italian Earthquakes* | **`Seismicity/CFTI_q.tab`** | Vector | Blue |
| • *from Catalogo Parametrico Terremoti Italiani* | **`Seismicity/CPTI_q.tab`** | Vector | Red |
| • *from NT4.1 Catalogue* | **`Seismicity/NT_q.tab`** | Vector | Violet |
| *Felt Reports:* | | | |
| • *from CFTI* | **`Seismicity/CFTIFelt.tab`** | Vector | Black/Red |
| • *from NT (before 1900 AD)* | **`Seismicity/NTFelt.tab`** | Vector | Black/Red |
| • *from NT (after 1900 AD)* | **`Seismicity/NTFelt.tab`** | Vector | Black/Red |
| *Previous Fault Compilations* | **`Geological/Compilations/ Compilations.tab`** **`Geological/Compilations/Maps/ *.tab`** | Raster | ------- |
| *Additional Geophysical/ Seismological Data* | **`Geological/Additional_Data/ Additional_Data_list.tab`** **`Geological/Additional_Data/*.tab`** | Vector or Raster | ------- |

#### 2.2.5.2.1. Seismological data: instrumental seismicity

Instrumental seismicity is taken from the monthly bulletin of the Istituto Nazionale di Geofisica e Vulcanologia for the period January 1987 - December 2000. The information supplied by the *Database* is a subset of the data that appear in the bulletin and retains the essential parameters such as hypocentral coordinates, origin time, magnitude and reliability of the solution. In particular, the *Q1* and *Q2* quality ratings range from A (most reliable) to D (least reliable) and are assigned based on the epicentral uncertainties and on the network configuration (azimuthal gap), respectively. Each earthquake is plotted as a solid white circle. The diameter of the circle (in km) corresponds to the expected source length obtained from the earthquake magnitude using Wells and Coppersmith's (1994) empirical relations.

2.2.5.2.2. Seismological data: historical seismicity

Historical seismicity is taken from the three largest compilations that were available at the end of 2000:

- NT 4.1.1 (Camassi and Stucchi, 1997), a parametric catalogue containing 2488 earthquakes that is largely based on the DOM 4.1 database of macroseismic observations (Monachesi and Stucchi, 1997);
- Catalogue of Strong Italian Earthquakes, 461 b.C. to 1997, or CFTI3 (Boschi *et al.*, 2000), the third version of a "new generation" catalogue containing parameters and basic data for 605 large Italian earthquakes;
- Catalogo Parametrico dei Terremoti Italiani (CPTI Working Group, 1999), a purely parametric catalogue derived from the two previous catalogues and containing 2480 earthquakes.

The three catalogues can be displayed separately or simultaneously (see above for colour-coding). Each earthquake is plotted as a coloured empty square. The size of the square (in km) corresponds to the expected source length obtained from magnitude ($M_s$ for NT 4.1.1, $M_e$ for CFTI 3, $M_a$ for CPTI) using Wells and Coppersmith's (1994) empirical relations.

The special function *Felt Reports* (a submenu of the menu *View*) allows the basic intensity data contained in the NT 4.1.1/DOM 4.1. and CFTI3 catalogues to be displayed as dynamic layers of the cartographic interface. All individual data available for a given earthquake (to be selected from a pick-list) are plotted along with a roman numeral identifying the assigned intensity. See § 3.2.3.9. for further information concerning this function.

2.2.5.2.3. Previous fault compilations

The *Previous Fault Compilations* are figures from articles or from the web or printed maps containing active faults, seismogenic faults and lineaments. The figures are representative of a wide selection of investigators and areas and the only requisite for their inclusion in the *Database* was the correctness of the figure's (map's) geographic layout. Each figure/map was georeferenced with the maximum accuracy allowed by its quality. The results are generally satisfactory with a mismatch between the raster image and the GIS grid that usually does not exceed 3 km (5-10 km at the far edges of some larger scale compilations).

A full list of the *Previous Fault Compilations* that are presented with the first version of the *Database* is supplied in Appendix III.

**Table structure: `Compilations.tab`**

| Field name | Content | Format |
|---|---|---|
| `Title` | Title or short description of given compilation | `Char(254)` |
| `Authors` | Author(s) of given compilation (see table for adopted format) | `Char(254)` |
| `Year` | Year of publication of the given compilation | `Char(16)` |
| `Reference` | Full reference of journal, proceedings, volume or book were the given compilation was published. Journal titles should be abbreviated according to the World List of Abbreviations followed by volume number, first and last page (see table for adopted format) | `Char(128)` |
| `TableName` | Name of table containing the given compilation | `Char(128)` |
| `Compilation_ID` | Encodes the given compilation by a progressive identification number | `Char(16)` |

2.2.5.2.4. Additional geophysical/seismological data

The *Database* may be complemented by other geophysical and seismological data that are pertinent to the general problem of identifying seismogenic sources, characterising their behaviour, or simply placing them in their tectonic context for further elaboration or representation purposes. These layers of data are fully georeferenced and may be accompanied by substantial alphanumeric information associated with the graphic objects. This information can be accessed using MapInfo® standard tools (*Info Tool*) and bears no logic link with the rest of the textual information presented in the *Database*. The actual availability of this type of support information may vary depending on the specific release of the *Database*.

A full list of the *Additional Geophysical/Seismological Data* tables that are presented with the first version of the *Database* is supplied in Appendix IV.

**Table structure: `Additional_Data.tab`**

| Field name | Content | Format |
|---|---|---|
| `Title` | Title or short description of given set of additional data | `Char(254)` |
| `Authors` | Author(s) of given set of additional data (see table for adopted format) | `Char(254)` |
| `Year` | Year of publication (or preparation, if unpublished) of the given set of additional data | `Char(16)` |
| `Reference` | Full reference of journal, proceedings volume or book were the given set of additional data was published. Journal titles should be abbreviated according to the World List of Abbreviations followed by volume number, first and last page (see table for adopted format) | `Char(128)` |
| `TableName` | Name of table containing the given set of additional data | `Char(128)` |
| `ID` | Encodes the given set of additional data by a progressive identification number | `Char(16)` |

### 2.2.5.3. Generic support tables

These tables contain information that may be used to place all the seismological and tectonic information in their geographic and administrative context. By definition, all these tables are also layers of the GIS. In the following schemes "Colour" specifies the colour used to represent the given graphic objects in the GIS, "Corresponding file(s)" specifies the location of the tables within the disk database. Since all the support tables are located in the folder **`Background_Info`**, this information is omitted.

2.2.5.3.1. Geographic and elevation data

The geographic interface of the *Database* is essentially based on a Digital Elevation Model (DEM) of Italy with a regular grid of about 240 m. This was re-sampled from a public-domain archive originally compiled by Carrozzo *et al.* (1985). The DEM was re-processed to obtain a *Colour Shaded Relief*, a *B/W Shaded Relief* and a *Colour Coded* version. These can be used interchangeably to emphasise specific features or to create the optimal contrast with the rest of the information displayed. The DEM can also be interchanged with a purely vectorial outline of Italy and surrounding countries that leaves all its inland portions devoid of any topographic information. The outline of European (except Italy) and North African countries is displayed also in conjunction with any of the realisations of the DEM.

The geographic interface is complemented by a series of tables that outline with different shades of blue the bathymetry of the seas surrounding Italy at 200, 500, 1000, 2000, 3000 and 4000 m depth. The bathymetry is automatically displayed in conjunction with any of the realisations of the DEM (with shades of grey for the B/W version).

The geographic grid is shown at fixed angular intervals that change with the scale of representation from 0.1° to 2°.

The drainage dataset is provided courtesy of E.N.E.L./Hydro (former I.S.M.E.S.) and is represented at three different levels of detail. The coarser level shows only the most important rivers country-wide (normally, all those having a length in excess of 20 km). The finest level includes most of the rivers and seasonal streams that can be derived from a 1:25000 scale map. The intermediate level contains a selection of the latter and in particular all first and second order streams.

The following scheme summarises the correspondence between standard and virtual names and the type of representation for all of the geographic and elevation data.

| Table name/menu item | Corresponding disk file(s) | Type | Colour |
|---|---|---|---|
| *Digital Topography:* | | | |
| • *Colour Shaded Relief* | `DEM/ShadedRelief/Ita*.tab` | Raster | Palette |
| | `DEM/Bathymetry/*CC.tab` | Vector | Palette |
| | `Geographic/EuroMed.tab` | Vector | Black |
| • *Colour Coded* | `DEM/ColourCoded/Ita*.tab` | Raster | Palette |
| | `DEM/Bathymetry/*CC.tab` | Vector | Palette |
| | `Geographic/EuroMed.tab` | Vector | Black |
| • *B/W Shaded Relief* | `DEM/BW/Ita*.tab` | Raster | Palette |
| | `DEM/Bathymetry/*BW.tab` | Vector | Palette |
| | `Geographic/EuroMed.tab` | Vector | Black |
| *Digital Topography:* | | | |
| • *Outline Only* | `Geographic/EuroMed_Outline.tab` | Vector | Black |
| *Geographic Grid* | `Grids/Grid_*.tab` | Vector | Black |
| *Drainage:* | | | |
| • *Main Rivers Only* | `Geographic/MainRiv.tab,Lakes.tab` | Vector | Blue |
| • *Main and Intermediate* | `Geographic/InterRiv.tab,Lakes.tab` | Vector | Blue |
| • *Full Drainage* | `Geographic/Idr*.tab,Lakes.tab` | Vector | Blue |

2.2.5.3.2. Administrative data

Most of these data are provided by I.S.T.A.T. (Italian national agency in charge of country wide statistics on economic and demographic data) and reflect the results of the 1991 national census. The layers *Large Cities* and *Intermediate Cities* include "capoluoghi di regione" and "capoluoghi di provincia", respectively. The *Small Towns* layer includes 8100 "comuni", the smallest territorial unit in the Italian public administration. The *All Localities* layer is supplied courtesy of E.N.E.L./Hydro (former I.S.M.E.S.) and includes 61595 «frazioni», small settlements that are under the jurisdiction of a "comune". To learn what "comune" corresponds to a given "frazione" use the codes provided with the table or simply plot the "frazione" along with the layer `Comuni_Borders.tab`.

The following scheme summarises the correspondence between standard and virtual names and the type of representation for all of the administrative data.

| Table name/menu item | Corresponding disk file(s) | Type | Colour |
|---|---|---|---|
| *Administrative Boundaries:* | | | |
| • *Regions* | `Administrative/Region_Borders.tab` | Vector | Black |
| • *Provinces* | `Administrative/Province_Borders.tab` | Vector | Black |
| • *"Comuni"* | `Administrative/Comuni_Borders.tab` | Vector | Black |
| *Cities:* | | | |
| • *Large Cities* | `Administrative/Large_Cities.tab` | Vector | Violet |
| • *Intermediate Cities* | `Administrative/Intermediate_Cities.tab` | Vector | Orange |
| • *Small Towns ("Comuni")* | `Administrative/Small_Cities.tab` | Vector | Yellow |
| • *All Localities ("Frazioni")* | `Administrative/Small_Localities.tab` | Vector | Blue |

### 2.2.5.4. Summary of support tables

The following scheme summarises the different categories of *Support Tables*, along with the indication of where each specific layer of information is described in better detail.

| Category | Table name/menu item | See section(s) |
|---|---|---|
| *Source Specific* | *Summaries of the Main Studies on the Source* | 2.2.5.1., 4.1.2. |
| *Source Specific* | *Comments and Open Questions* | 2.2.5.1., 4.1.2. |
| *Source Specific* | *Pictures* | 2.2.5.1., 4.1.3. |
| *Source Specific* | *References* | 2.2.5.1., 4.1.4. |
| *Source Generic* | *Instrumental Earthquakes* | 2.2.5.2.1. |
| *Source Generic* | *Historical Earthquakes:* | 2.2.5.2.2. |
| | • *from CFTI3 catalogue* | |
| | • *from CPTI catalogue* | |
| | • *from NT4.1.1 Catalogue* | |
| *Source Generic* | *Felt Reports:* | 2.2.5.2.2. |
| | • *from CFTI3 catalogue* | |
| | • *from NT 4.1.1/DOM (before 1900 AD) catalogue* | |
| | • *from NT 4.1.1/DOM (since 1900 AD) catalogue* | |
| *Source Generic* | *Previous Fault Compilations* | 2.2.5.2.3., 4.2. |
| *Source Generic* | *Additional Geophysical/Seismological Data* | 2.2.5.2.4., 4.3. |
| *Generic* | *Digital Topography:* | 2.2.5.3.1. |
| | • *Colour Shaded Relief* | |
| | • *Colour Coded* | |
| | • *B/W Shaded Relief* | |
| | • *Outline Only* | |

| | | |
|---|---|---|
| *Generic* | *Geographic Grid* | 2.2.5.3.1. |
| *Generic* | *Drainage:*<br>• *Main Rivers Only*<br>• *Main and intermediate*<br>• *Full Drainage* | 2.2.5.3.1. |
| *Generic* | *Administrative Boundaries:*<br>• *Regions*<br>• *Provinces*<br>• *"Comuni"»* | 2.2.5.3.2. |
| *Generic* | *Cities:*<br>• *Large Cities*<br>• *Intermediate Cities*<br>• *Small Towns ("Comuni")*<br>• *All Localities ("Frazioni")* | 2.2.5.3.2. |