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Database of Active Faults of Eurasia

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Abstract. The principles underlying construction of the database of active faults of Eurasia are presented. They include the data required for computer construction of the Map of active faults and other information.

The database (DB) represents a collection of ASCII files and contains data on more than 6000 faults of Eurasia. DB is supplied with a program package for the read–out of cartographic information and data processing and is compatible with all the basic geoinformatic systems.

The database of active faults of Eurasia① has been developed at the laboratory of neotectonics and remote sensing of the Geological Institute, RAS, within the framework of the project II –2 "World Map of Major Active Faults" of the International Lithosphere Program (ILP). Its content and structure meet two essential requirements: as comprehensive as possible geological descriptions of faults (objects presented in the database), and formalized presentation of the data (description) of the objects.

The underlying material for the database is regional maps of active faults in scales not 1:2,500,000 or more detailed, constructed and accompanied with descriptions in the legend adopted. These initial data were being first subjected to checking and tests in order to match adjacent sheets of the Map, then all the faults were being digitized, their description formalized. Resultant data formed data files.

The fault attributes required to be reflected in the database were their geographic location, kinematics (sense of fault motions) and their age (here, the time of manifestation of the latest fault activity), as well as indication of the method (methods) and reliability of identification of a fault, of a source of the data (publication, verbal reports, and so on).

The geographical location of a fault is determined in the database by the set of geographical coordinates of points belonging to its (broken) line. The accuracy of determination of a fault line is considered sufficient, if it corresponds to the accuracy of topographical maps of the scale of 1:2,500,000. In those cases, when geographical information of different degree of accuracy was available, preference was always given to the more comprehensive information (e.g., location with GPS receivers).

The structure of the database is quite simple – all information is recorded in text files, containing description of some number of faults of a certain territory. In any of the files, each fault

① The terms "active", "an active fault" adopted herein areexplained in the paper "The Map of Active Faults in Eurasia: Principles, Methods, and Results" by V.G.Trifonov in this issue.

has its own number and a set of obligatory and complementary rows (the number of the latter depends on the volume of the available data). Each row begins with a certain mark (a two–digit integer value), corresponding to the particular fault parameter, followed by the actual value of the parameter. A comprehensive list of fault parameters utilized is given in Appendix 1. For example, row 54 R indicates that the given faults is a reverse fault ("54" is the nark of the row with the description of the fault kinematics, R is the parameter value designating the reverse fault motion), row 95 A means that we deal with the most reliable (according to the three–point scale) fault identification.

Special marks indicate the beginning and the end of the fault description. If some information concerning the fault is missing (as in quite a large percentage of events) the corresponding rows in a file are omitted.

The applied methods of recording information allows us to convey it easily to other users (in the form of ASCII files) and to transport it to various geographical informational systems (GIS). For example, the program included in the DB permits transferring the data to such popular GIS, as Spans and ArcInfo.

The database has the means required for inputting new data, for their visualization on the display and drawing maps, for the data retrieval, thus, what makes it a specifically oriented "mini–GIS". The data recorded in the DB in a coded form, can be transformed into regular verbal form (see Appendix 2).

At present, the database delivers information about more than 6,000 individual faults, characterizing active tectonics practically of the whole Eurasia, with the exception of North Europe (see the map–insert in this issue of the journal).

Appendix 1. List of main entries in the active fault database with fault parameters and / or parameters values

1. Fault name

2. Geometry of the fault line or the projection of the buried fault onto the land's surface (geographical coordinates of the broken line vertices).

3. Age (the time of the last fault movements) – 5 divisions:

1 – historical,

2 – active in the Late Pleistocene and Holocene (last 0.1 million of years)

3 – active in the Middle Pleistocene (between 0.7 and 0.1 million of years)

4 – active in the Late Pleistocene

5 – reliably active in the Middle Pleistocene and supposedly active in the Late Pleistocene and Holocene.

4. Rate of fault motions, its range in mm, assumed as characteristic to the fault throughout the time of its activity, 3 divisions,

$v > 5 mm / a$

$1 \leqslant v < 5 mm / a$

$v < 1 mm / a$

5. Angle (or range) at which the fault plane dips, with indications of which site or part of the fault is characterized by the value,

6. Sense of fault movements:

normal,

reverse (fault plane steeper than 45°),

thrust (fault plane not steeper than 45°),

right–lateral,

left–lateral

extensional, that is, not accompanied with considerable either vertical or lateral displacements

vertical

unknown

When there are various components of the fault motions detected, their combination, predominance of one of them or their ratio is indicated

7. Age of the last movements along the fault or of other manifestations of the fault activity, indicated either in years or symbols of geological time–scale: Q_2 – the Middle Pleistocene, or its part (Q_2^1 – Early, Q_2^2 – Late), Q_3 – the Late Pleistocene, or its part (Q_3^1 – Early, Q_3^2 – Late), Q_4 – the Holocene, or its part (Q_4^1 – Early, Q_4^2 – Late).

8. Faulted strata and penetration depth:

sedimentary,

upper part of the consolidated crust,

lower part of the consolidated crust,

upper mantle.

9. manifestation of hidden (buried) faults on the Earth's surface:

sharp change in the pattern of young structures across the projection of the fault plane onto the Earth's surface,

flexure,

fold zone,

en echelon arranged structures of compression,

en echelon arranged tensile structures,

enhanced fracturing,

concentration of landslides and other gravitational effects,

gas–hydro–geochemical anomalies.

10. signs of fault activity:

geological and geomorphologic:

displacement or deformation of young sediments,

displacement or deformation of relief elements,

displacement or deformation of a valley , etc.,

displacement or deformation of terraces, fans, and so on,

change in the composition and / or thickness of young sediments,

young displacement at depth, revealed by seismic profiling.

seismological, seismotectonic and geophysical:

chains of earthquake epicenters,

focal mechanism solutions,

modern or historical earthquake–caused rupturing,

paleo–seismic dislocations,

geophysical data about fault movements at depth.

geodetic and historical:

repeated geodetic measurements,

displacement of ancient constructions or of natural objects, if the latter underwent displacement in historical times.

hydro–thermal, hydro–geochemical, volcanological:

chains of volcanoes and manifestations of fissuring volcanism,

modern hydro–thermal manifestations,

evidences of palae–thermal activity,

mud volcanoes and data on abnormally high stratum pressure in the fault zone,

modern gas–hydro–chemical or hydro–geochemical processes, manifested as anomalies in the fault zone.

indirect structural and geological:

concentration of landslides or other exogenous manifestations and geodynamic activity,

structural manifestations above the active fault zone (flexures, fold or fracture systems, and so on).

detected using remote sensing data:

displacements of deformation of relief elements, seen on aerial or orbital imageries,

remote–recorded anomalies and their variation in the fault zone, interpreted as manifestations of modern geodynamic activity,

anomalies in topography, seen on orbital imageries.

11. Data on the age of displacement or other manifestations of fault activity:

radiometric

tephra chronological

paleo–magnetic,

lichenometric,

historical,

archaeological,

instrumental,

geological correlation with dated formations,

and others.

12. Amplitudes of the Quaternary (not older than 700 Kyr B.P.) displacements, in m, with indications of the sense of motions, time interval, the displacement occurred in, and the site (point, fault segment or part), the displacement were measured at.

13. Velocity of fault movements, as calculated from the observed displacement, when the latter is dated, or followed from repeated geodetic measurements, etc., accompanied with indications of the sense of motion, and the site, the velocity value refers to.

14. seismic manifestations in the fault zone.

15. Reliability of the fault identification and of the data relevant to it:

reliable,

satisfactory,

unreliable (hypothetical interpretation).

16. References:

Each fault description includes an entry indicating the source and type of data. Besides this, each data file contains list of references, in a form, usual for publications.

Appendix 2. An example of the data file of the Sakhalin active faults (extraction, transformed into verbal form)

Fault N 2

Active in Q_3–Q_4

Velocity < 1 mm / a

NORTHERN SAKHALIN strike–slip f.z. (en element)

Dextral fault

Offset or deformation of topography

The SW fault side uplifted

Reliability mediate

Kozhurin, A.I., after V.S.Rozhdestvensky data

54–17.05lat 142–37.50Lon

54–13.58Lat 142–39.10Lon

etc.

Translated by G. Pontecorvo and V. Tropin