SEISMIC VELOCITY STRUCTURE AND FOCAL MECHANISMS OF THE UMBRIA MARCHE REGION CENTRAL ITALY FROM LOCAL EARTHQUAKES TOMOGRAPHY

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Introduction

Following the 26 September 1997 Colfiorito earthquakes, seismicity occurred for several months along a normal fault system composed by several adjacent NW trending segments distributed from Gualdo Tadino, in the north, to Sellano in the south. Earthquakes were recorded by several temporary seismic networks. We joined data collected from about 100 permanent and temporary seismic stations for a total complete dataset of several thousands of aftershocks.
We present high resolution 3-D images of the Umbria-Marche region (central Italy) as derived from the inversion of P and S wave arrival times from 2000 crustal earthquakes belonging to the seismic crisis. Moreover, from the 3-D location of earthquakes, 550 focal mechanisms have been calculated by using the first polarities method.
In fig. 1 we show the epicenters and main shocks of the sequence on the geological maps of the region. Fig. 2 shows the seismic stations (red triangles), seismicity of the area (Md>3.0) and main historical events from CPTI (Boschi et al., 1997)

Geology

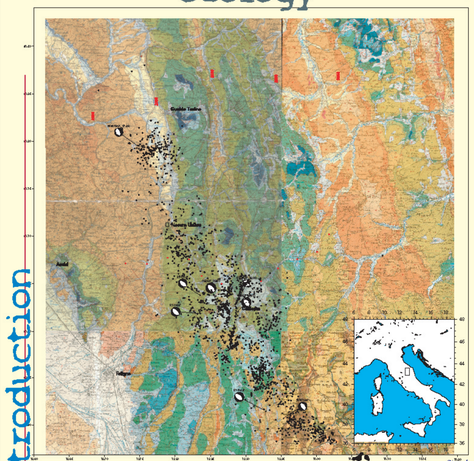

fig 1

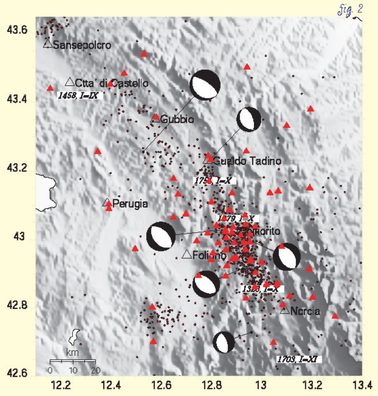

fig 2

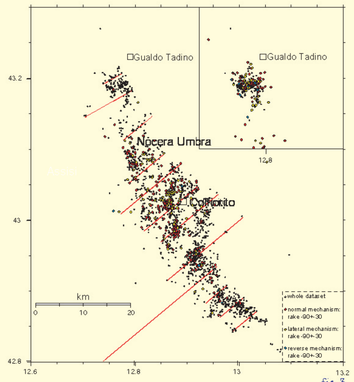

fig 3

Seismicity

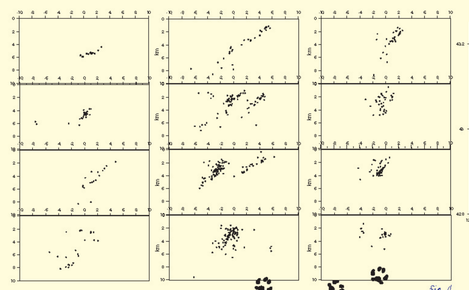
fig 4

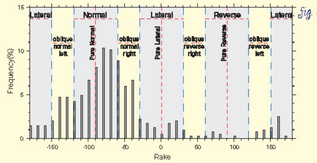

fig 5

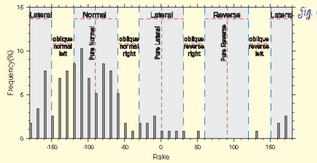

fig 6

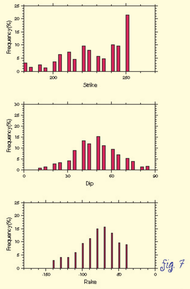

fig 7

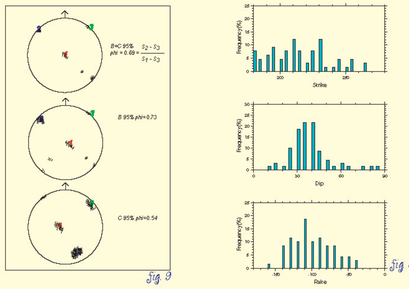

fig 8

fig 9

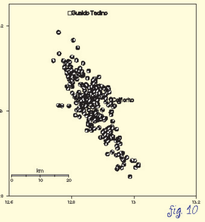

fig 10

Focal mechanisms obtained by using the first polarities; more than 16 observations.

Histogram of the rake of the calculated aftershocks focal mechanisms showing their kinematics range for Colfiorito area (fig. 5) and Gualdo Tadino (fig. 6).
Fig. 7 and 8 show the histogram of strike, dip and rake for the SW-dipping normal faults.
In fig. 9 stress inversion from the focal mechanisms solution of the whole dataset (A), Colfiorito (B) and Gualdo Tadino (C) [Michael, 1984].
Analysis of the azimuth and plunge of P and T axes for Colfiorito (figg. 12, 13) and Gualdo Tadino (figg. 14, 15).

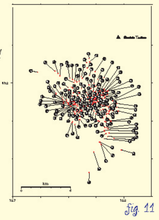
fig 11

Focal mechanisms obtained by using the first polarities; more than 8 observations.

Kinematic Analysis

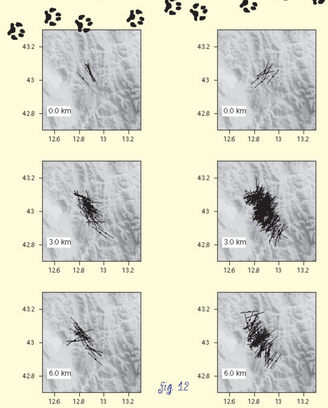

fig 12

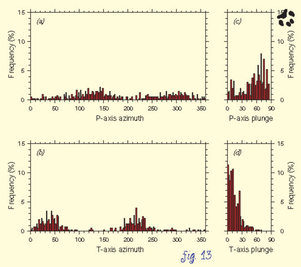

fig 13

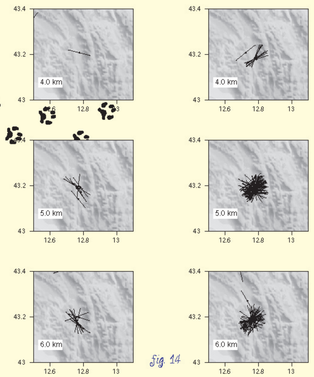

fig 14

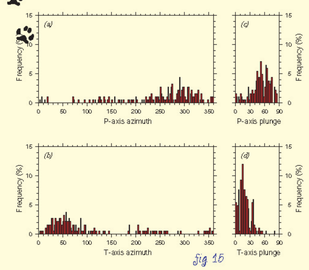

fig 15

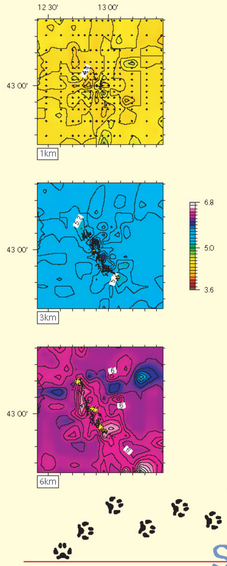

fig 16

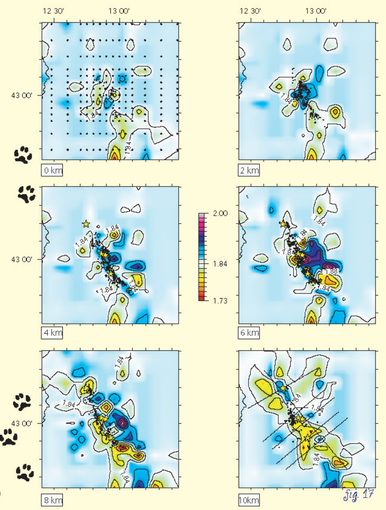

fig 17

Seismic Tomography

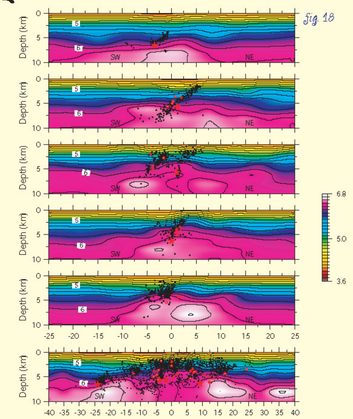

fig 18

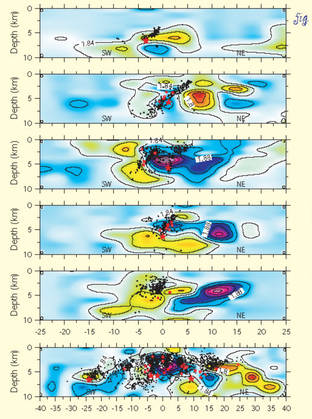

fig 19

We inverted P- and S-P arrival times from more than 3000 earthquakes for Vp, Vp/Vs and Hypocenters parameters with the Simulps technique [Thurber, 1983; Eberhart-Phillips, 1993; Eberhart-Phillips and Michael, 1998].
The lateral heterogeneities revealed by tomographic images allows us to identify the deep structure along the fault zone. The analysis offer us the possibility to define the complex fault system, the kinematics and the rupture evolution and segmentation. The main pre-existing high Vp thrust are recognized. Fault plane solutions from mainshocks and aftershocks reveal a main system of SW-dipping normal faults, a small number of solutions occurred on shallower N-S strike-slip faults, and horizontal extension perpendicular to the Apennine chain.

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