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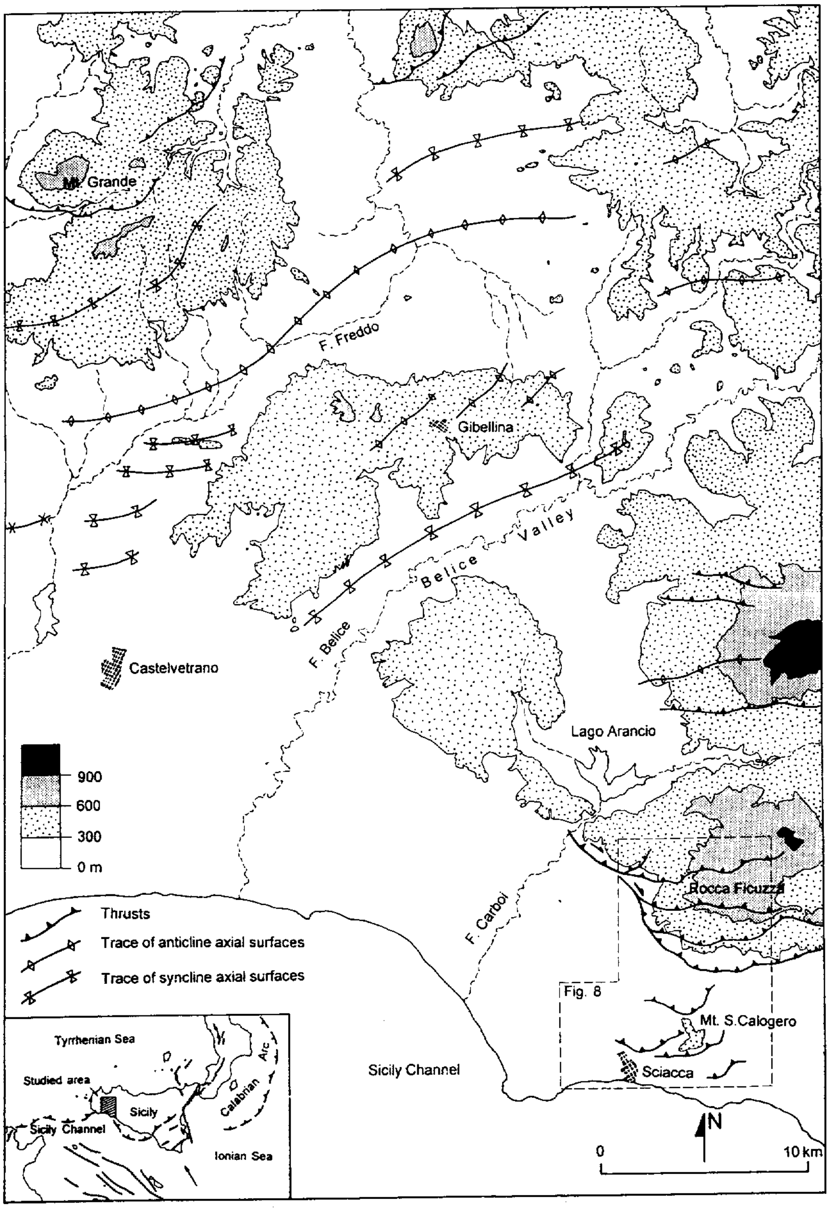

Fig. 1. *Morphotectonic map of the Belice Valley. Thrust faults and traces of axial surfaces of the major folds are from fieldwork and analysis of SPOT images. Topography is from 1:25,000 I.G.M. topographic maps. Inset: Tectonic sketch map of Southern Italy; the thin arrow shows the Tortonian to Present direction of convergence between Africa and Europe (from Mazzoli and Helman, 1994), whereas large open arrows indicate the mean extension direction occurring in Calabrian Arc and Eastern Sicily (from Tortorici* et al.*, 1995). Lines with triangles indicate the front of the thrust belt, lines with barbs the main Quaternary normal faults.*

for about 35 km along its major axis, from Castelvetrano to Contessa Entellina (Fig. 2). The major shocks ($M \geq 5$), relocated by Anderson and Jackson (1987) and listed in Table 1, are grouped in the area extending between Poggioreale and S. Margherita Belice (Fig. 2).

Analysis of focal depth distribution can only reliably be carried out for these relocated events. In a NNW-trending section, roughly normal to the major axis of the seismic area, the shocks tend to align along a N-dipping surface characterized by an approximate inclination of 60° (a–a′ in Fig. 3). In a WSW section (b–b′ in Fig. 3), on the contrary, the focal depth distribution does not show any pattern, the shocks being grouped into three main clusters which do not allow a single plane to be traced.

Available focal mechanisms for the best constrained events are also reported by McKenzie (1972) and by Anderson and Jackson (1987). Pure thrust solutions along ENE-trending and N-dipping planes (Fig. 4a,b) are suggested by McKenzie (1972), whereas Anderson and Jackson (1987) indicate either NNW-striking planes, dipping steeply to the WSW, with a right-lateral component of motion (Fig. 4c–e) or alternative solutions as pure thrust mechanisms (Fig. 4c′–e′) similar to those proposed by McKenzie (1972).

The damage produced by the seismic sequence was spread over the Belice Valley (De Panfilis and Marcelli, 1968; Bosi *et al.*, 1973). The first three shocks of the sequence, which occurred on 14 January with $4.7 < M < 5.1$ (Table 1; Fig. 2), caused significant damage to the small towns of Gibellina, Montevago, Poggioreale, Salaparuta, Santa Margherita Belice, Santa Ninfa and Menfi. On 15 January, at 02 h 02 min 09 s, the main shock ($M = 5.4$) struck the Belice Valley increasing the damage produced by the previous events. The towns of Montevago, Salaparuta and Gibellina were completely destroyed; Poggioreale, Santa Margherita Belice, Santa Ninfa and Menfi were ruined whereas severe damage affected the villages of Partanna, Vita and Salemi. Further damage was caused by the earthquakes that successively occurred on 16 and 25 January ($M = 5.1$).

The cumulative damages associated to the whole earthquake sequence (data from De Panfilis and Marcelli, 1968) are reported in Table 2. Based on these data, a map has been constructed, showing contours of equal total damage resulting from the percentage of severely damaged or completely ruined buildings (Fig. 5). This map gives a clear macroseismic picture of the 1968 earthquake. The maximum ground-shaking areas, corresponding to a damage percentage larger than 80%, define an 18 km-long ENE–WSW elongated zone including the towns of Santa Ninfa, Gibellina, Salaparuta and Poggioreale, and an isolated area that corresponds to Montevago. Cumulative damage contour

Table 1. Location of major shocks of Belice Valley earthquake sequence (from Anderson and Jackson, 1987).

Event N.	Date	Hour	Lat.	Long.	Depth	M
1	14/1/1968	12h 28m	37°48′16″	13°00′43″	19	5.1
2	14/1/1968	13h 15m	37°40′34″	12°57′58″	1	5.0
3	14/1/1968	15h 48m	37°49′48″	12°58′59″	22	4.7
4	15/1/1968	01h 33m	37°49′01″	13°00′21″	34	5.1
5	15/1/1968	02h 01m	37°45′00″	12°58′59″	13	5.4
6	15/1/1968	03h 18m	37°47′35″	12°57′36″	23	4.6
7	16/1/1968	16h 42m	37°51′25″	12°58′34″	36	5.1
8	25/1/1968	09h 56m	37°41′13″	12°57′58″	3	5.1

lines of 50% and 15% exhibit an overall elliptical shape with ENE–WSW major axes having lengths of 35 and 50 km, respectively.

The pattern of epicentral distribution (Fig. 2) and the cumulative damages contour map (Fig. 5), together with the available focal mechanisms (Fig. 4), strongly suggest that the seismogenic zone might be orientated along an ENE–WSW direction. Focal depth distribution indicates a northward dip, with an angle of about 60°, for this zone (Fig. 3), which agrees with pure thrust fault plane solutions.

STRUCTURAL DATA

The area shaken by the 1968 earthquakes lies in the central segment of the fold and thrust belt of Western Sicily, a portion of the S-verging branch of the Alpine orogenic belt (Fig. 1). The fold and thrust belt developed as a result of post-collisional NNW-directed convergence between Africa and Europe from the late Tortonian to the Present (Mazzoli and Helman, 1994). It involves (Fig. 6) Mesozoic–Palaeogene carbonate successions, representing the sedimentary cover of a segment of the southern continental palaeomargin of Neotethys (Catalano and D'Argenio, 1978, 1982; Mascle, 1979), and Miocene terrigenous sediments. This succession is in places tectonically overlain by Numidian Flysch allochtonous terranes and/or by unconformable foredeep/piggy-back Upper Miocene–Pleistocene deposits (Mascle, 1974; Vitale, 1990).

The carbonates present in the thrust belt belong to a peritidal/pelagic carbonate platform and basin system (Santantonio, 1994) which developed during Mesozoic rifting and passive margin evolution. The thrust sheets juxtapose different portions of this carbonate system, preserving, however, a complete record of the original lithofacies distribution, as platform, margins and basin areas. In particular Upper Cretaceous calcareous megabreccias (Mascle, 1979), most probably associated to the major basin-bounding normal fault scarps, represent clear markers of the margins of intra-platform Cretaceous shallow basins (Fig. 7).

The overall geometry of the thrust belt consists of ENE-striking frontal ramps (Fig. 6), laterally joining NW-trending oblique ramps characterized by right-lateral components of motion. Striae and calcite shear fibres on slickensides surfaces from both frontal and oblique ramps indicate an overall SSE (N160–170°E) thrust transport direction.

The southern part of the thrust belt (Sciacca thrust front, Fig. 8) is characterized by several ENE-striking, tightly spaced imbricate thrust sheets, mainly involving Mesozoic to Palaeogene carbonate platform sediments (Catalano *et al.*, 1978) These form two major imbricate fan systems: a southern one, in the Monte San Calogero area and a northern one, in the Rocca Ficuzza area (Fig. 7). The main thrust fault of the Monte San Calogero imbricate fan runs at the base of the southern cliff of Monte

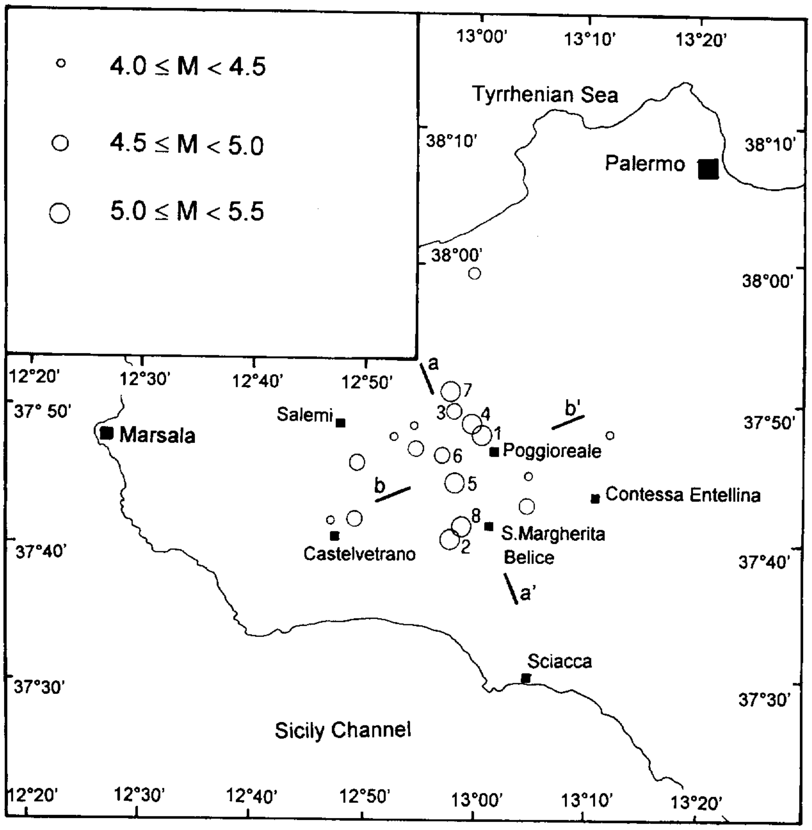

Fig. 2. *The epicentral distribution and magnitude of the 1968 earthquake sequence in western Sicily. The numbers beside the circles refer to major relocated shocks listed in Table 1 (data from De Panfilis and Marcelli, 1968; Anderson and Jackson, 1987).*

Table 2. Damages percentage occurred during the 1968 Belice Valley earthquake sequence (data from De Panfilis and Marcelli, 1968).

Town	Ruined (%)	Severely damaged (%)	Total (%)
Gibellina	100	—	100
Poggioreale	100	—	100
Salaparuta	100	—	100
Montevago	99	1	100
S. Ninfa	43	47	90
A. Margherita Bel.	70–80	—	70–80
Partanna	30	42	72
Salemi	24	45	69
Menfi	—	40–50	40–50
Contessa Entellina	2	35	37
Vita	10	15	25
Camporeale	1	24	25
Roccamena	—	17	17
Castelvetrano	2	9	11
Sambuca	—	8	8

San Calogero, where Triassic dolomites are exposed. The hanging wall defines a large ramp anticline (Fig. 9) in which the whole succession is involved, including shallow water algal limestones uplifted to an altitude of up to about 350 m. The algal limestones (Fig. 8), unconformably overlying Upper Pliocene-Lower Pleistocene (Calabrian) clays (Buccheri, 1970; Magné *et al.*, 1972) and truncated by a continental erosion surface of Sicilian age (Bianchini and Mascle, 1971), are roughly dated as 1.0–0.7 Myr old. This observation suggests an activity from the Middle Pleistocene (0.7 Myr) for the Monte San Calogero structure. Several minor thrusts splay out from the main fault, defining a trailing imbricate fan involving Upper Pliocene–Pleistocene sediments in its frontal parts (Figs 8 and 9). Small piggy-back Holocene lacustrine basins occur in the depressed area north of the main thrust ramp underlying the Monte San Calogero imbricate fan, thus suggesting a young activity of the frontal parts of the thrust belt.

The Rocca Ficuzza imbricate fan consists of a leading imbricate fan system defined by a major frontal thrust whose footwall is represented by the succession that presently forms the backlimb of the Monte San Calogero ramp anticline (Fig. 8). The most impressive features occur at Rocca Nadore, where Triassic dolomites and stratigraphically overlying Jurassic–Lower Cretaceous condensed sequences overthrust Middle-Upper Miocene marls and sandy marls (which, in turn, tectonically overlie Upper Pliocene marls and clays), and at Rocca Ficuzza, where Upper Cretaceous calcareous breccias overthrust the Lower Pliocene sediments belonging to the backlimb of the Rocca Nadore thrust-related fold (Figs 6 and 7).

It is worth noting that (i) Upper Pliocene sediments invoved in the deformation contain blocks of calcareous breccias suggesting therefore that thrust sheet emplacement occurred during this time ($\approx$ 2 Myr) and that (ii) the front of the Rocca Ficuzza thrust sheet represents the southern boundary of the Upper Cretaceous calcareous breccias (Fig. 7).

To the north, from Lago Arancio to the Montagna Grande thrust ramp, Upper Miocene–Pliocene sediments related to a foredeep/piggy-back basin system extensively crop out (Fig. 6). They form a wide synformal depression (Belice syncline), filled by Upper Pliocene

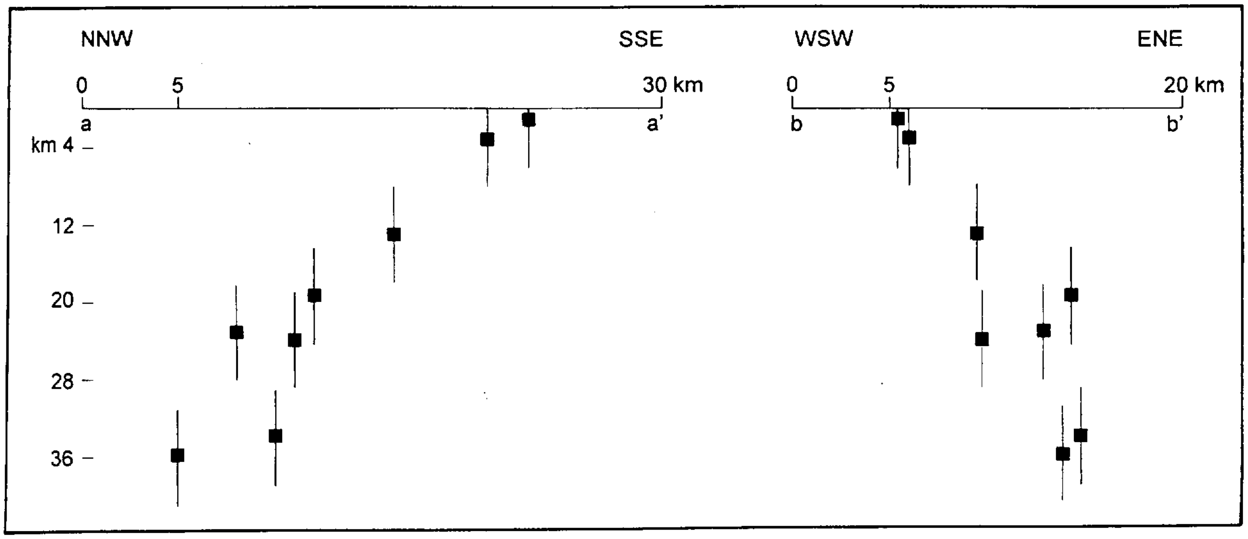

Fig. 3. *Focal depth distribution, along NNW and WSW striking sections (location in Fig. 2) of the major shocks of the 1968 earthquake sequence relocated by Anderson and Jackson (1987).*

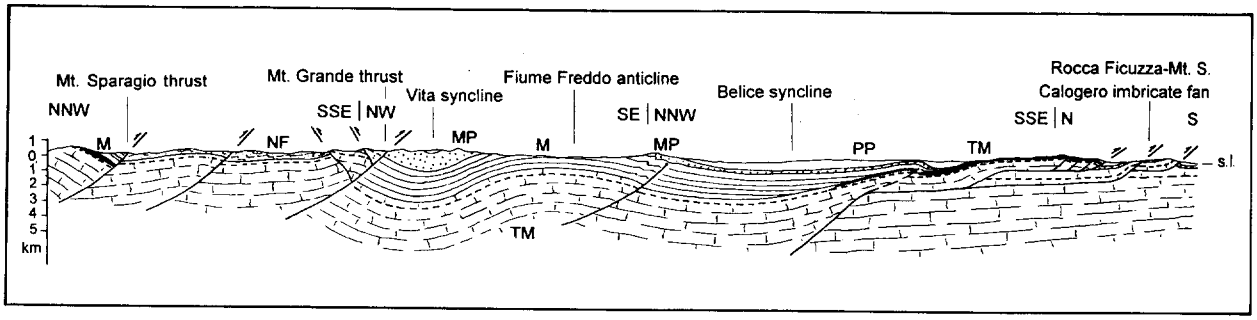

Fig. 7. *Geological cross-section between Mt. Grande and Sciacca (location in Fig. 6). TM, peritidal-pelagic carbonate platform and basin system deposits (Trias–Middle Miocene); NF, Numidian Flysch Nappe (Upper Oligocene–Middle Miocene); M, marls and sandy marls (Middle–Upper Miocene); MP, clastics, evaporites and marls (Upper Miocene–Lower Pliocene); PP, calcarenites, marls and sandstones (Upper Pliocene–Middle Pleistocene). Dashed line indicates Middle Liassic to Lower Cretaceous condensed pelagic deposits. Shaded areas at the top of TM indicate Upper Cretaceous calcareous megabreccias.*

interpreted as representing a large fault-propagation fold related to the upper Pliocene blind thrust bordering the Belice syncline to the north (Fig. 7). A large open kink, most probably related to back-thrusting at depth, affects the backlimb of the Fiume Freddo anticline where Messinian evaporites are also involved.

The Vita syncline, a NE-trending structure lying in the footwall of the NE-striking Montagna Grande thrust system (Fig. 7), is characterized by the occurrence, within the succession exposed in its fold limbs, of a clastic wedge, about 1300 m-thick, made up of Upper Tortonian coarse-grained terrigenous deposits and Messinian clastics and evaporites. This clastic wedge was deposited right in front of the uplifted active margin of a small foreland basin, thus representing a proximal facies of a foredeep succession. This implies that the major activity of the Montagna Grande thrust occurred during the Late Miocene (≈ 7–5 Ma).

From Montagna Grande to the north, the thrust sheets made up of Mesozoic to Palaeogene carbonate sequences passively carry on top of them a previously emplaced nappe made of Lower–Middle Miocene Numidian Flysch. The Montagna Grande system is a complex structure involving the whole carbonate sequence and the tectonically overlying Numidian Flysch nappe. Minor back thrusts splay out from the main fault of the system, defining a composite pop-up structure (Fig. 7). Reimbrication (breaching) produced local inversions of the original stacking order, leading to tectonic superimposition of the carbonate sequence onto the already emplaced Numidian Flysch nappe.

At the northern edge of the cross-section, Upper Cretaceous calcareous megabreccias crop out in the hanging wall of the Monte Sparagio thrust ramp (Fig. 7). The occurence of large volumes of these megabreccias along the main thrust fault of Rocca Ficuzza and in the S-dipping monocline of Monte Sparagio outlines the margins of a fault-bounded basin which was later inverted during contractional deformation. The important role of inversion processes in the western Sicilian fold and thrust belt is suggested by the occurrence of facies changes across thrust contacts and, more generally, by the correspondence between the main tectonic and stratigraphic units of the area, thus producing the so-called 'tectonostratigraphic units' (Catalano and D'Argenio, 1978).

DISCUSSION AND CONCLUSIONS

The general architecture characterizing the studied transect of western Sicily represents the results of the evolution of a foreland migrating ENE–WSW striking thrust system developing from the late Miocene to the Holocene. This feature represents, therefore, an important geological constraint for any interpretation of the seismic activity that characterizes Western Sicily. From this point of view, it should be stressed how the epicentral area of the 1968 earthquake sequence corresponds to a weakly deformed Neogene sedimentary wedge located between two major thrust ramps of the orogenic belt (Fig. 7). This area, characterized by large-scale open folds, does not show any evidence of neotectonic fault structures (Fig. 6). Recent structures are indeed clearly exposed in the southern part of the thrust belt, along the Sciacca thrust front which affects Quaternary deposits represented by 1.0–0.7 Myr old algal biocalcarenites (Fig. 8). They are involved in a large ramp anticline uplifting them to a maximum altitude of 346 m, implying a long-term vertical throw rate of ≈ 0.35–0.5 mm yr^{-1} for this structure. Furthermore, lacustrine satellite basins of Holocene age occurring on the back of this large ramp anticline indicates a late Quaternary activity of the underlying thrust.

Taking into account that the dip angles of the ramp segments of the Sciacca thrust front have values of about 60°, a uniform Quaternary slip rate of about 0.5 ± 0.1 mm yr^{-1} may be inferred (Avouac *et al.*, 1993). This value may be also assumed as a minimum estimate for the flat from which the ramps of the Sciacca thrust front splay out.

Both the epicentral distribution (Fig. 2) and the cumulative damage contour pattern (Fig. 5) show an overall ENE–WSW trend, roughly parallel to the structures of the thrust and fold belt. Furthermore, ENE–WSW striking planes represent the only common solutions (Fig. 4) to the focal mechanisms proposed by different authors

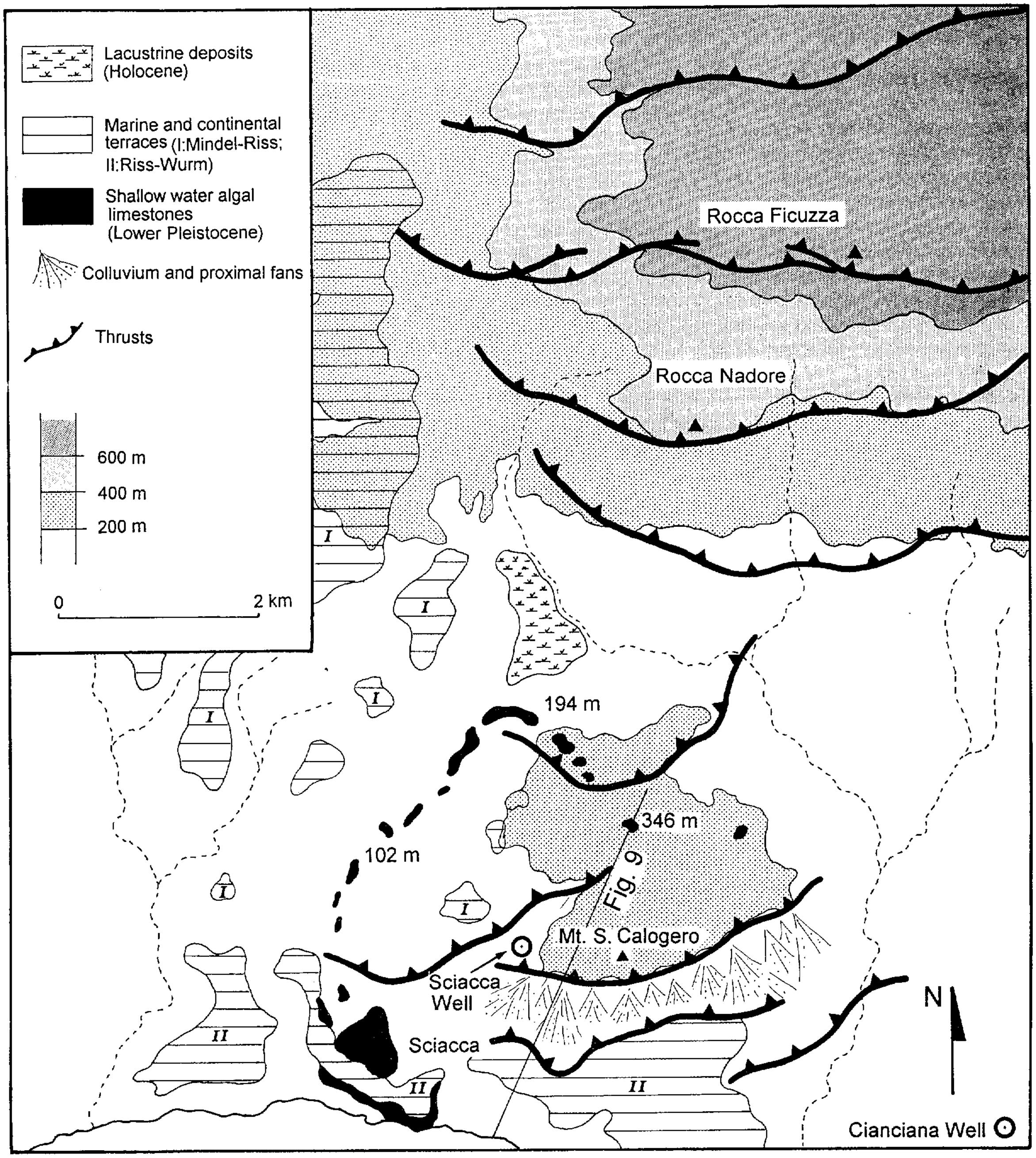

Fig. 8. *Morphotectonic map of the Sciacca area (location in Fig. 1). Thrust faults are from fieldwork, elevation countour lines from 1:25,000 I.G.M. topographic maps.*

(McKenzie, 1972e; Anderson and Jackson, 1987). Moreover, NNW-dipping planes are in good agreement with the hypocentral distribution which defines, along a NNW–SSE profile, a roughly 60° dipping plane (Fig. 3).

Both geophysical and geological observations provide strong evidence that a steeply NNW-dipping thrust ramp (Fig. 10) ruptured during the 1968 earthquake sequence. According to this hypothesis, the active crustal thrust ramp under the Belice Valley area remains blind. Instead of surfacing immediately to the south of the most devastated area, the thrust flattens into a flat detachment within the sedimentary cover. The thickness of the stratigraphic succession involved in thrusting together with the geometry of thrust-related folds (see Suppe, 1983) allow us to locate the depth of the detachment at about 2 km. Displacement along the flat detachment gives rise to a series of

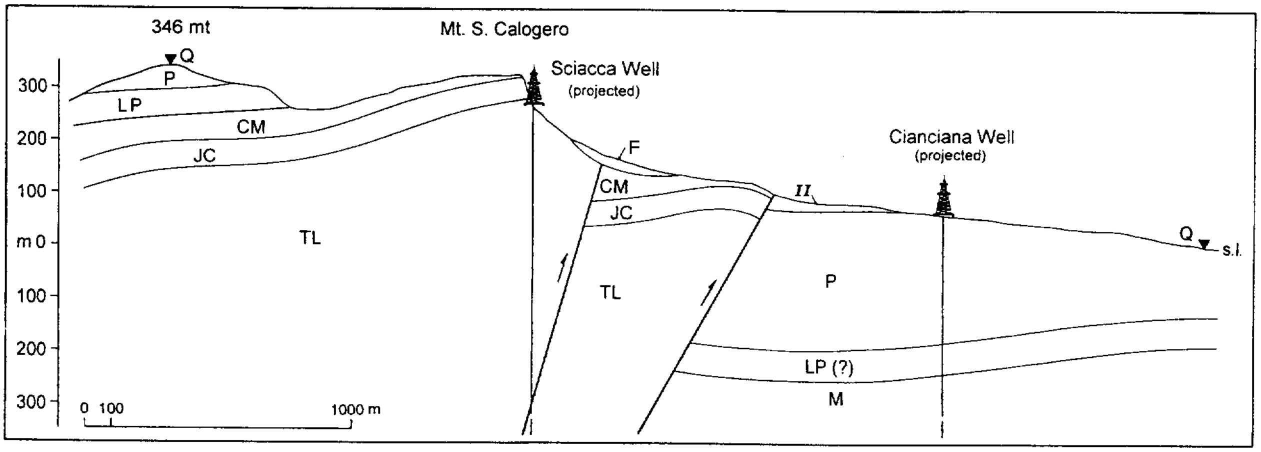

Fig. 9. *Geological profile of Mt. San Calogero thrust fault (location in Fig. 8). TL, Triassic to Lower Liassic carbonate platform deposits; JC, Middle Liassic to Lower Cretaceous condensed pelagic deposits; CM, Upper Cretaceous to Middle Miocene carbonate sediments; M, Upper Miocene terrigenous deposits; LP, Lower Pliocene marly limestones; P, Upper Pliocene–Lower Pleistocene marly clays; II, Upper Pleistocene marine terrace. Triangles (Q) indicate Lower Pleistocene shallow-water algal limestones.*

minor ramps, until they reach the surface in the Sciacca thrust front about 20 km away from the main crustal ramp. Considering the epicentral distribution, cumulative damage contours and size of surface structures, such as large folds (Belice syncline, Fiume Freddo anticline) and imbricate thrust fans (Rocca Ficuzza imbricate fan, Monte San Calogero imbricate fan), would suggest a possible width of about 40 km for the buried active structure. Such a crustal ramp might represent an original steep segment of a Mesozoic normal fault inverted during Neogene contractional deformation as a consequence of continental collision induced by the NNW directed African–European convergence.

The serious damage in the epicentral area would thus be related to the shaking associated to the deep shocks, without any occurrence of nearby surface breaks. Slip along the crustal ramp is therefore transferred to the complex flat-ramp system located at shallow depth to the foreland (Fig. 10). Along this path, crustal shortening tends to be absorbed by folding and flexural slip within surface layers. According to Avouac *et al.* (1993), about two thirds of the total slip at depth are distributed into diffuse strain and folding accommodation processes. As displacement for earthquakes with $M < 5.5$ is of the order of a few centimetres (Lyon-Caen *et al.*, 1988), the slip dispersion at shallow levels as described above reduces the surface displacement to undetectable values. The fact that the 1968 earthquake sequence, characterized by events with $M < 5.4$, did not produce any surface break, is also in perfect agreement with the observation that thrust earthquakes with $M < 6.5$ rarely break the surface (Avouac *et al.*, 1993).

The 1968 earthquake sequence was most probably the result of multiple small ruptures of the thrust plane rather than the consequence of a single rupture over the entire fault. According to this hypothesis, the shallowest shocks (numbered 2 and 8 in Table 1) can be explained by slip along a near surface blind thrust splay and associated flexural slip folding (Fig. 10).

Due to the extremely limited amounts of surface deformation associated with deep multiple shocks with $M < 5.5$, this mode of rupture is unlikely to explain the surface vertical throw observed in the Sciacca thrust ramp anticline at the

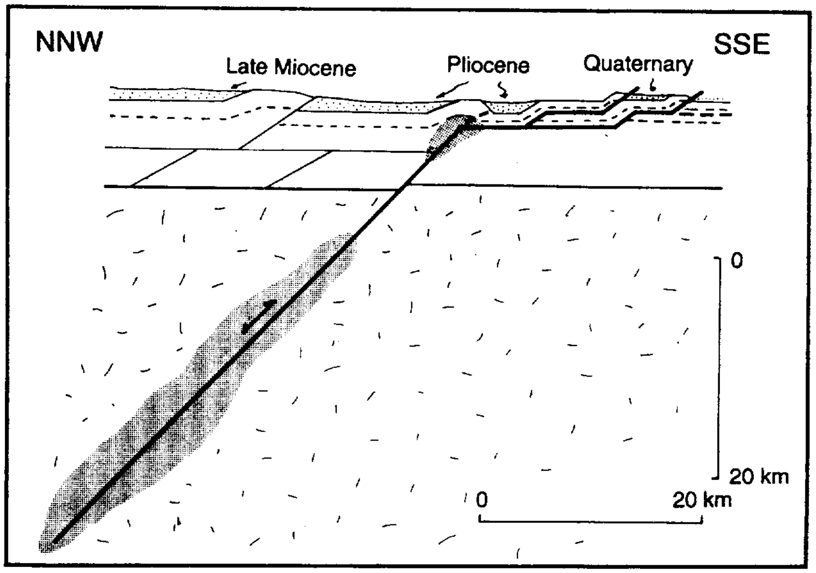

Fig. 10. *Interpreted section across active structures of southwestern Sicily. The shaded areas correspond to the rupture zone of major events ($M \geq 5$) of the 1968 earthquake sequence.*

southermost edge of the onshore active thrust system. It is therefore suggested that coherent motion on large fault patches or over the entire thrust fault must occasionally occur, thus implying that earthquakes of larger magnitude ($M \geq 6.5$) than those of the 1968 sequence can be expected in this area (although such large events have not been recorded in historical times). Therefore, it is suggested that more detailed quantitative morphological and structural studies must be carried out along the recent structures of the frontal part of the western Sicily thrust and fold belt, to test the largest possible earthquake associated with the active structures and its possible recurrence interval.

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REFERENCES

Anderson H. and Jackson J. (1987) Active tectonics of the Adriatic Region, *Geophys. J. R. astr. Soc.*, **91,** 937–983.

Avouac J.P., Tapponnier P., Bai M., You H. and Wang G. (1993) Active thrusting and folding along the northern Tien Shan and Late Cenozoic rotation of the Tarim relative to Dzungaria and Kazakhstan, *J. geophys. Res.*, **98,** 6755–6804.

Bianchini G. and Mascle G. (1971) Nouvelle observations sur le Quaternaire de Sicile méridionale, C. *R Acad. Sci. Paris*, **272,** 200–202.

Bosi C., Cavallo R. and Francaviglia V. (1973) Aspetti geologici e geologico-tecnici del terremoto della Valle del Belice del 1968, *Mem. Soc. Geol. Ital.*, **12,** 81–130.

Bottari A. (1973) Attivitá sismica e neotettonica della Valle del Belice, *Ann. Geofis.*, **26,** 55–84.

Buccheri G. (1970) Una malacofauna calabriana del territorio di Sciacca (Sicilia sudoccidentale), *Geol. Romana*, **9,** 239–274.

Catalano R. and D'Argenio B. (1978) An essay of palinspastic restoration across Western Sicily, *Geol. Rom.*, **17,** 145–159.

Catalano R., D'Argenio B., Montanari L., Renda P., Abate B., Monteleone S., Macaluso T., Pipitone G., Di Stefano E., Lo Cicero G., Di SteXano P. and Agnesi V. (1978) Contributi alla conoscenza della struttura della Sicilia occidentale (l) il profilo Palermo-Sciacca, *Mem. Soc. geol. Ital.*, **19,** 485–493.

De Panfilis M. and Marcelli L. (1968) Il periodo sismico della Sicilia occidentale iniziato il 14 Gennaio 1968, *Ann. Geofis.*, **21,** 243–420.

Gasparini C., Iannacone G., Scandone P. and Scarpa R. (1982) Seismotectonics of the Calabrian Arc, *Tectonophysics*, **84,** 267–286.

Lyon-Caen H., Armijo R., Drakopoulos J., Baskoutass J., Delibassis N., Gaulon R., Kouskouna V., Latoussakis J., Makropoulos K., Papadimitriou P., Papanastassiou D. and Pedotti G. (1988) The 1986 Kalamata (South Peloponnesus) Earthquake: detailed study of a normal fault, evidences for east-west extension in the Hellenic Arc, *J. geophys. Res.*, **93,** 14967–15000.

Magné J., Mascle G. and Mongin D. (1972) Stratigraphie des formations du Miocène terminal au Quaternaire en Sicile sud-occidentale, *Bull. Soc. Geol. Fr.*, **7,** 147–158.

Marcelli L. and Pannocchia G. (1971) Uno studio analitico sui dati ipocentrali di 10 terremoti avvenuti in Sicilia occidentale nel Gennaio 1968, *Ann. Geofis.*, **24,** 287–306.

Mascle G. (1974) *Carte géologique des Monts Sicani.* I.R.E.S., Palermo.

Mascle G. (1979) Étude géologique des Monti Sicani, *Riv. It. Paleont. Stratigr.*, **16,** 1–431.

McKenzie D. (1972) Active tectonics of the Mediterranean Region, *Geophys. J. R. astr. Soc.*, **30,** 109–185.

Mazzoli S. and Helman M. (1994) Neogene patterns of relative motion for Africa-Europe: some implications for recent central Mediterranean tectonics, *Geol. Rndsch.*, **83,** 464–468.

Ruggieri G. and Torre G. (1973) Geologia delle zone investite dal terremoto del Belice, *Riv. Min. Sic.*, **139–141,** 27–48.

Santantonio M. (1994) Pelagic Carbonate Platforms in the geologic record: Their Classification, and Sedimentary and Paleotectonic Evolution, *Bull. Am. Ass. Petrol. Geol.*, **78,** 122–141.

Suppe J. (1983) Geometry and kinematics of fault bend folding, *Am. J. Sci.*, **283,** 684–721.

Tortorici L., Monaco C., Tansi C. and Cocina O. (1995) Recent and active tectonics in the Calabrian arc (Southern Italy), *Tectonophysics*, **243,** 37–55.

Vitale F.P. (1990) Studi sulla valle del medio Belice (Sicilia centro-occidentale). L'Avanfossa plio-pleistocenica nel quadro dell ' evoluzione paleotettonica dell' area, *PhD thesis*, University of Palermo, 201 pp.

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