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Radiocarbon dating of active faulting in the Agri high valley, southern Italy

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Abstract

The high valley of the Agri River is a wide intermontane basin located in the Lucanian Apennine, southern Italy. This basin was formed during Quaternary times in the hinterland of the Neogene fold-and-thrust belt. Tectonics has strongly controlled shape, morphology and sedimentary evolution of the basin up to the present. The Agri Valley, in fact, has been hit by recurrent and large earthquakes such as the 1857 Basilicata earthquake. Pleistocene extensional tectonics is commonly envisaged as responsible for the basin evolution. On the grounds of new structural studies, indeed, the valley appears to be a more complex structure than a simple extensional graben, as traditionally assumed in the literature, or than a pull-apart basin, as suggested by some workers.

The basin floor is filled by middle Pleistocene faulted alluvial deposits. A new survey has shown evidence of deformation also in younger sediments. At Viggiano, located along the eastern flank of the basin, recent slope deposits still attached to their source area display fault-controlled sedimentation. In this area, different climate-sedimentary cycles represented by coarse breccia talus alternated with palaeosoils are involved in the recent deformation. At Pergola, located a few kilometres northwest of the Agri high valley, the most recent fan deposits found at the foot of a major slope, including evenly bedded breccia and intercalated palaeosoils, are strongly faulted and tilted.

In order to establish precise chronological constraints, palaeosoils have been sampled in several sites and at different stratigraphic levels. Radiocarbon dating supports the field evidence of very recent deformation associated to relevant displacements, yielding ages between 40 and 20 ka.

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1. Introduction

Faulted recent palaeosoils represent the best field evidence of active tectonics and their study and dating a powerful tool to understand the seismotectonic picture of a very active region such as southern Italy. We found this kind of feature in several sites from the high part of the Agri Valley, a wide graben located in the axial zone of the southern Apennines (Fig. 1). Historical seismicity of that area is well-known as well as the kinematics of the relevant early and middle Pleistocene tectonic activity (Giano et al., 1997a,b). Yet, the time span from the late Pleistocene to Present is surely the least known from a tectonic point of view, because of the lack, until now, of good exposures of deformed stratigraphic markers younger than 100 ka. The contribution of this paper is to provide new ages of deformation through ^{14}C dating of faulted palaeosoils recently discovered, and to discuss the regional meaning of such deformation. In order to establish precise chronological constraints, palaeosoils have been sampled in several sites all along the basin (Pergola, Marsico Nuovo, Galaino, Marsico Vetere, Viggiano) and at different stratigraphic levels. Three of these horizons — coming from sites aligned along a NW–SE structural trend (Fig. 2) parallel to the elongation of the basin — have been fruitful for the radiocarbon dating.

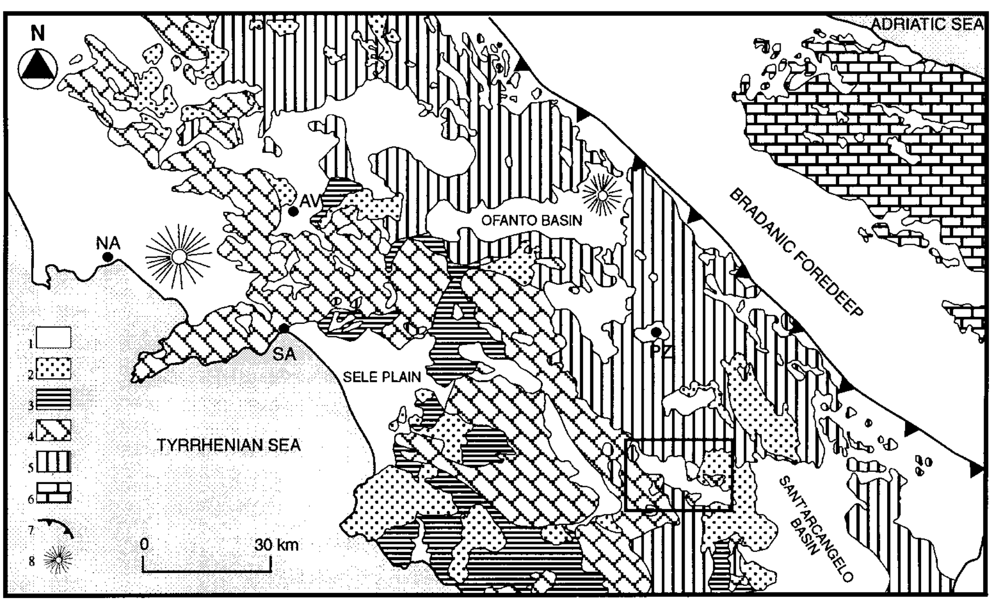

Fig. 1. Geological sketch map of the southern Apennines (location of the study area in the black frame). Legend: (1) Pliocene–Quaternary clastics and Quaternary volcanics; (2) Miocene syntectonic deposits; (3) Jurassic to Oligocene ophiolite-bearing internal units and Cretaceous to Oligocene deep-sea shaly units (Ligurian and "Sicilide complex" units); (4) Mesozoic–Cenozoic shallow-water carbonates of the Campania–Lucania platform; (5) lower-middle Triassic to lower-middle Miocene shallow-water and deep-sea successions (Lagonegro units); (6) Mesozoic–Cenozoic shallow-water carbonates of the Apulian platform; (7) thrust front of the chain; (8) volcanoes.

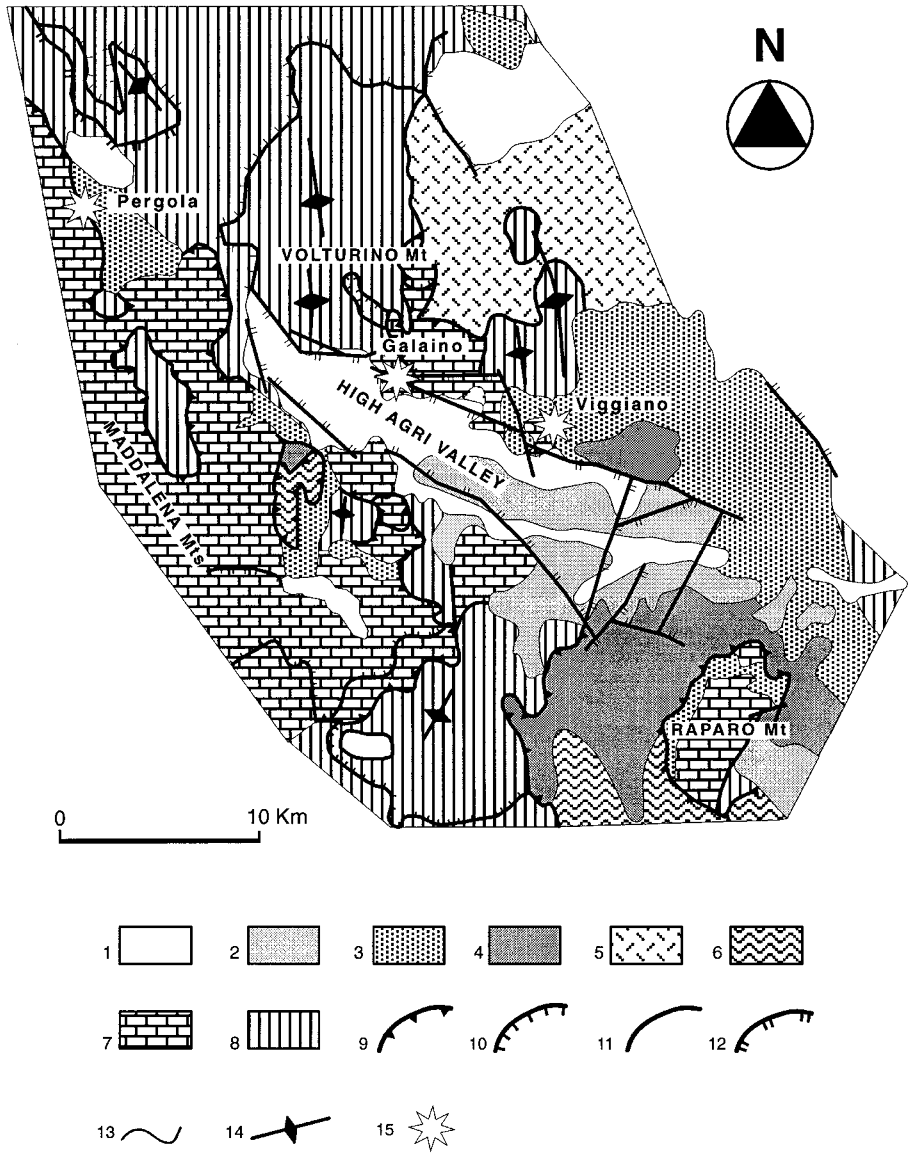

Fig. 2. Geological sketch map of the Agri high valley. Legend: (1) Recent alluvial deposits (Holocene–upper Pleistocene); (2) alluvial deposits (upper-middle Pleistocene); (3) siliciclastic and carbonate flysch deposits — Monte Sierio Formation, Gorgoglione Flysch (upper-middle Miocene); (4) siliciclastic and carbonate flysch deposits — Albidona Formation (middle-lower Miocene); (5) "Sicilide complex" units (Oligocene–upper Cretaceous); (6) North Calabrian Unit (Eocene–Cretaceous); (7) carbonate platform and slope units (lower Miocene–upper Triassic); (8) Lagonegro units (lower Miocene–middle-lower Triassic); (9) thrust between different units; (10) thrust within the same unit; (11) undetermined tectonic contact; (12) Quaternary normal fault; (13) stratigraphic contact; (14) anticline axial trace; (15) sampling site.

2. Regional framework

The southern Apennines are a NE-verging orogenic wedge accreted from late Oligocene–early Miocene to Pleistocene. The chain is composed of Mesozoic–Cenozoic sedimentary cover from several palaeogeographic domains (i.e. the Ligurian oceanic crust and the western passive margin of the Adriatic plate) and of the Neogene–Pleistocene piggyback basin and foredeep deposits of the active margin. Recent shortening occurred at the belt front deforming Pleistocene sediments and volcanics (Pieri et al., 1997; Beneduce and Schiattarella, 1997) whereas widely documented extension is still active along the Apennines axis (Ortolani et al., 1992; Amato and Selvaggi, 1993). The average trend of the chain axis is about N150°, corresponding to the strike of the main thrusts and coaxial normal faults. The belt is also affected by Plio-Quaternary strike-slip faults mainly oriented according to N120° $\pm$ 10° and N50–60° trends (Schiattarella, 1998, and references therein) and by low-angle normal faults (Ferranti et al., 1996, and references therein).

In a regional cross-section moving from the Tyrrhenian Sea to the Adriatic (Apulian) foreland, and from the top to the bottom of the accretionary wedge, the following tectonic units are observed (Prosser et al., 1996): (1) Jurassic to Oligocene polydeformed ophiolitic units (Knott, 1987; Mauro and Schiattarella, 1988; Monaco and Tortorici, 1995), unconformably covered by syntectonic deposits of early Miocene age (Ligurian units, Bonardi et al., 1988a); (2) a carbonate platform unit (Campania–Lucania platform), ranging in age from late Triassic to early Miocene (D'Argenio et al., 1975); (3) several units mainly composed of deep-sea sediments, ranging in age from early Triassic to lower-middle Miocene (Lagonegro units, Scandone, 1967); (4) a frontal imbricate fan made up of Cretaceous to lower Miocene deep-sea marls, shales and sandstones (Pescatore et al., 1997) covered by middle to upper Miocene flysch deposits (Pescatore, 1988); (5) Pliocene to Pleistocene foredeep clastic deposits (Casnedi, 1988; Pieri et al., 1996); (6) the Apulian carbonate platform, which has been partly incorporated at the base of the accretionary wedge, also representing the eastern foreland area (Mostardini and Merlini, 1986). A shortening of approximately 200 km is estimated for the southern Apennines wedge, excluding the internal deformation of the Ligurian units (Schiattarella et al., 1997).

3. Geological outline and Quaternary structural evolution of the Agri high valley

The high valley of the Agri River is a NW–SE trending intermontane basin located in the Lucanian Apennine (Fig. 1), along the axial zone of the chain. This fault-bounded basin is about 30 km long and 12 km wide and was formed during Quaternary time in the hinterland of the fold-and-thrust belt after the major Miocene–Pliocene episodes of shortening. Tectonics has strongly controlled shape, morphology and sedimentary evolution of the basin up to the present. As a matter of fact, historical seismicity shows that the Agri high valley has been hit by recurrent and large earthquakes such as the 1857 Basilicata earthquake. Early Pleistocene displacement along the boundary faults is dramatically evidenced by coeval slope deposits which are tilted and uplifted at various elevations along the basin flanks. The basin floor is filled by middle Pleistocene alluvial deposits which are faulted as well. Extensional tectonics is commonly envisaged as responsible for basin evolution.

The pre-Quaternary bedrock (Fig. 2) is made of Mesozoic–Cenozoic shallow-water and slope carbonates (Monte Marzano–Monti della Maddalena Unit; Bonardi et al., 1988b), mainly outcropping along the western side of the basin, thrust onto coeval pelagic successions (Lagonegro units, Scandone, 1967) which crop out mainly along the eastern flank of the valley. Toward east and south-east, the bedrock is formed by Tertiary siliciclastic sediments (Albidona Fm, Gorgoglione Flysch) which occupy the southern part of the high valley (Carbone et al., 1991). To a lesser extent, Cretaceous to Oligocene shaly units — believed to be of oceanic origin — are also present in that area. All these units underwent strong contractional tectonics during Miocene–Pliocene mountain building. In Quaternary times, the contractional structures have been cut by high angle faults with different kinematics, which led to the genesis of the Agri high valley and controlled depositional architecture and landscape evolution (Fig. 3). The Quaternary sediments are entirely constituted of continental clastics (Fig. 4), represented by lower to upper Pleistocene slope coarse-grained deposits, which form coalescent fans along the

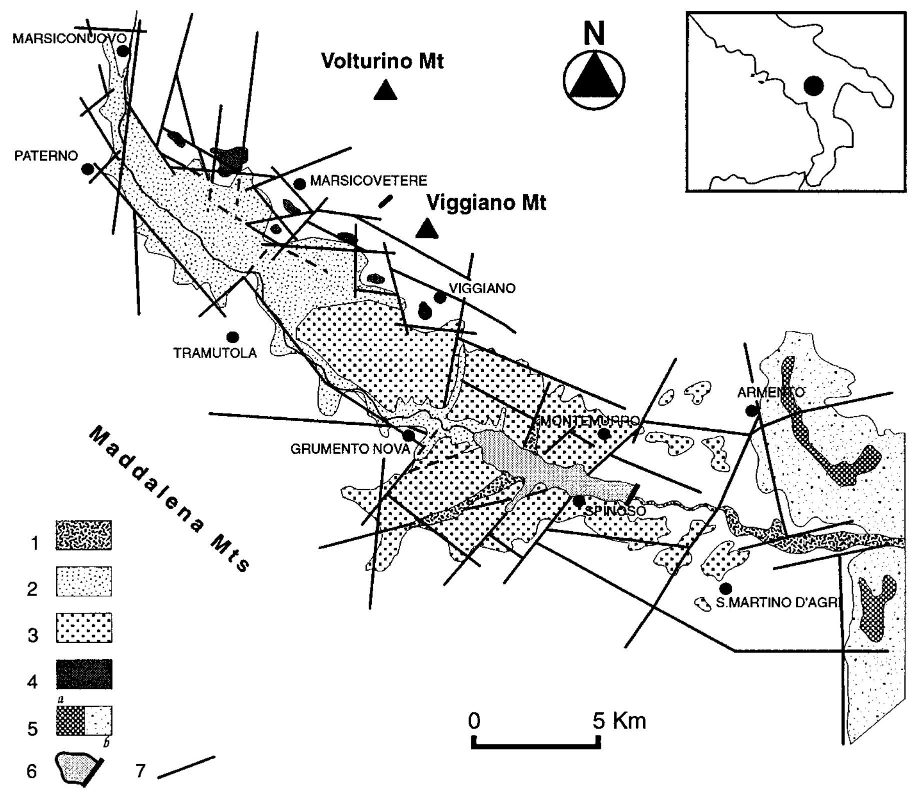

Fig. 3. Map showing the Quaternary deposits of the Agri valley and major faults. Legend: (1) Recent alluvial deposits; (2) alluvial deposits (Holocene–upper Pleistocene); (3) alluvial deposits ("Complesso Val d'Agri", Di Niro et al., 1992, upper-middle Pleistocene); (4) subaerial slope deposits (middle-lower Pleistocene); (5) Conglomerates and sands of the Sant'Arcangelo basin (Serra Corneta Fm [a] and Castronuovo Fm [b], lower Pleistocene); (6) Pietra del Pertusillo dam; (7) faults. Pre-Quaternary units are not shown.

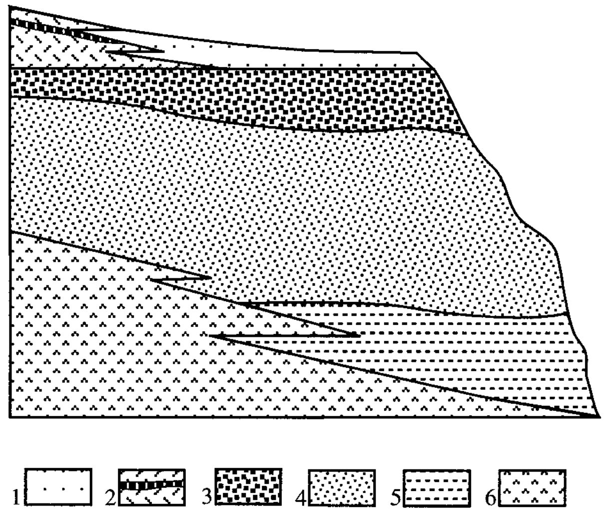

Fig. 4. Stratigraphic relationships among Quaternary deposits. Legend: (1) Recent colluvial and alluvial deposits; (2) coarse-grained slope deposits with interbedded palaeosoils (Holocene–upper Pleistocene); (3) Complesso Val d'Agri: upper interval (upper-middle Pleistocene); (4) Complesso Val d'Agri: intermediate interval (middle Pleistocene); (5) Complesso Val d'Agri: lower interval (middle-?lower Pleistocene); (6) coarse-grained slope deposits (middle-lower Pleistocene).

flanks of the basin, and by middle Pleistocene alluvial deposits in the plain ("Complesso Val d'Agri", Di Niro et al., 1992). Due to recent fluvial erosion, it is possible to observe more than 100 m of the alluvial sequence in several points.

The lower Pleistocene slope deposits are formed by roughly stratified breccias with reddish matrix, locally up to 20–30 m thick, which are strongly deformed and often uncoupled from the original sedimentary feeding and/or not connected to the alluvial plain. On the contrary, upper Pleistocene breccias are mostly still attached to the source areas and their tectonic deformation is hardly detectable. The middle-upper Pleistocene alluvial succession is made of three sedimentary units which are from the bottom to the top: (1) brownish-grey silty clay and silt, 20–30 m thick (fluvial-lacustrine and overbank deposits); (2) about 80 m thick alternation of gravel, silty sand and silt with interbedded conglomerates (alluvial plain deposits); (3) massive poligenic coarse-size conglomerates, up to 10 m thick (proximal fan deposits). The ages of the Quaternary sediments have been inferred by correlating some morphostratigraphic features of the Agri high valley with post-Sicilian features from the nearby Sant'Arcangelo Pliocene–Pleistocene basin (Di Niro et al., 1992). The entire Pleistocene succession reaches a thickness of about 250 m in the depocenter, as documented by unpublished well data. It is likely that part of the unknown basal facies may represent the distal counterpart of the ancient slope breccias outcropping along the flanks of the basin at different elevations.

On the grounds of recent geomorphological and structural studies (Di Niro and Giano, 1995; Giano et al., 1997a, 1998; Cello et al., 1998; Schiattarella et al., 1998), the valley appears to be a more complex structure than an extensional graben, as traditionally assumed in the literature (see for example Ortolani et al., 1992), or than a simple pull-apart basin, as suggested by Turco and Malito (1988).

The new data show that the genesis and the early Pleistocene evolution of the Agri basin were controlled by N120°-trending left-lateral strike-slip master faults, reactivated as normal faults since middle Pleistocene times. Indeed, N120°-striking faults are regional tectonic structures responsible for the genesis of many Quaternary intermontane basins of the southern Apennines and their kinematic history is quite similar all along the chain (Schiattarella, 1998).

During the first stage, a large E–W trending stepover of the master faults was responsible for the opening of the Agri paleobasin, which was filled by lower(?)-middle Pleistocene deposits presently preserved in the southern part of the high valley. N–S striking transpressional structures are also linked to the same kinematics being generated by restraining bends of the master faults, or reactivation of inherited faults. The first case is represented by small ridges of folded slope deposits outcropping along the eastern flank of the valley near the Galaino village (Giano et al., 1997a); an example of the second case comes from the scarp close to the Pergola village, where a dextral transpressional fault displaces Triassic dolomite (Fig. 2).

A second generation of lineations on fault planes (Giano et al., 1997a; Schiattarella et al., 1998) documents the extensional regime with an inferred NE–SW ("counter-Apenninic") tensile axis (Amato and Montone, 1997). This allowed for accumulation of the alluvial deposits also in the northernmost portion of the basin. Such a tectonic regime still persists, as inferred by the regional seismicity (Amato and Selvaggi, 1993), and as proved by the occurrence of the palaeosoils involved in normal faulting, hereafter described.

4. Field description of the sampling sites

4.1. Pergola

This site is located about 7 km north-west of the northern apex of the Agri high valley, along the western slope of the Maddalena Mts (Fig. 2). The slope is developed within the more erodible clayey and silty terrains of the Lagonegro units, and is flanked by the more resistant dolomite of the Monte Marzano–Monti della Maddalena Unit.

The contact between the two different units is represented by a major N–S striking high-angle fault which shows an en échelòn arrangement at the southern termination. The master

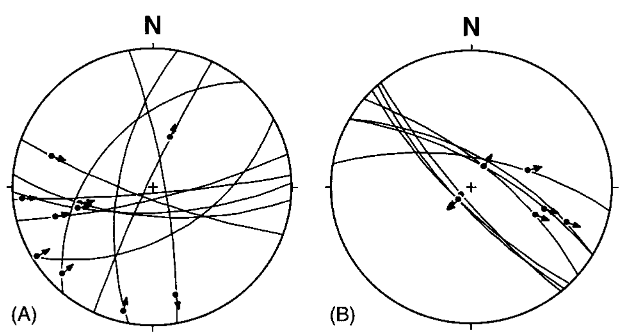

Fig. 5. Stereoplots of transpressional faults from Pergola site (a) and transtensional and extensional faults from Galaino site (b) (Wulff net, lower hemisphere).

fault plane dips mountainward, and shows evidence for Pleistocene transpressional kinematics (Fig. 5), as suggested by a talus breccia and a 0.3 m thick palaeosoil involved in faulting at the foot of the scarp.

Below the scarp, a trench for building foundation has allowed for inspection of a 5 m thick wall (Fig. 6). Two deposits have been distinguished within the exposed slope. The lower deposit, which represents most of the outcropping sequence, is composed of angular, evenly bedded and moderately classed carbonate gravel and sand. The deposit reaches a composite thickness of 12–15 m. It is faulted and tilted mountainward by northward striking extensional faults, which post-date the transpressional set. The beds show a rapid lateral variability in thickness mostly due to synsedimentary faulting. The deposit includes a heterogeneous unit of palaeosoils and detrital layers, in which four horizons may be distinguished from the bottom: (1) a palaeosoil made of a 10–15 cm thick layer of brown silt; (2) a 50–60 cm thick horizon of crudely stratified breccia, formed by cm-size, subangular to subrounded limestone clasts included in abundant matrix of clayey silt; (3) a palaeosoil made of 15–20 cm thick red-brown silty clay, capped in turn by (4) a 10–15 cm thick layer of brown plastic clay with small-size limestone clasts. The dated sample (PA3A) comes from the lowest horizon (1) of the unit.

The four horizons, although varying in thickness, can be easily followed along the 10 m long outcrop. Small-scale normal faults, consistent in geometry with the main fault set which tilted the deposit, are responsible for the development of flow and drag structures in the clay.

Fig. 6. Pergola site (sample PA3A): faulted debris slope deposits with interbedded palaeosoils (see text for details).

The upper deposit is separated from the underlying tilted breccia and sand by a well developed unconformity (Fig. 6). The former deposit is about 1.5 m thick on average and is made of two different lithologic units. The lower one is an evenly developed brown to red palaeosoil which fills channels and cavities above the unconformity and tends to regularize the underlying rough profile of the tilted breccia and sand. The palaeosoil is blanketed by a 0.5 m thick colluvium sheet grading upward into the present soil.

4.2. Viggiano

The village of Viggiano is built on a spur of Cretaceous limestone referred to the Monte Marzano–Monti della Maddalena Unit. This outcrop is found on the eastern flank of the Agri high valley (Fig. 2). This lower ridge is structurally downthrown from the higher mountain ridge of the eastern flank by several faults, and is in turn bounded to the valleyside by the present valley border fault. Possible listric geometry of the faults is inferred by tilting of talus breccia deposits, locally involved in faulting.

Along the north-eastern side of the spur, a faulted palaeosoil is well exposed in a 2–10 m deep trench for building foundation (Fig. 7). The palaeosoil is tilted by a fault locally dipping mountainward, but which is synthetic to the major faults bordering the eastern flank of the

Fig. 7. Viggiano site (sample PA7): debris slope deposits and palaeosoil involved in faulting (hanging-wall) and pre-Quaternary siliciclastic and carbonate deposits in the footwall (see text for details).

Agri valley and dipping basinward. This fault juxtaposes the palaeosoil against Mesozoic limestone and Miocene siliciclastic sediments.

The palaeosoil shows clear growth relationships with the fault, and has a maximum thickness close to the fault (about 1.2 m) and decreases rapidly to become 0.5–0.8 m on average. The palaeosoil is heavily dragged along the fault. The dated sample (PA7) has been collected 1.5 m away from the fault off the disturbed zone of dragging (Fig. 7).

The small open syncline formed by dragging of the palaeosoil is filled by massive carbonate breccia with coarse clasts in scarce matrix, which displays a crude bedding. This unit is 0.5–0.8 m thick and is covered by a thin clay level, which laps on the basal dragged clay. Although not directly involved in faulting, the breccia has likely accumulated during the final motion episodes on the fault as suggested by its mountainward stratigraphic expansion.

An upper depositional unit 0.3–0.5 m thick truncates both the hanging-wall and the footwall and clearly seals motion on the fault. The deposit is formed by a better organized breccia with subrounded carbonate clasts, whose long axis lies parallel to the slope, and grade upward into the present, regularized soil.

4.3. Galaino

At this site, located on the northern portion of the eastern border of the valley (Fig. 2), lower Pleistocene subaerial slope deposits have been found involved in transpressional folding (Fig. 8). Transpression is documented by a push-up ridge of the bedrock (here represented by the upper Triassic Calcari con Selce Fm of the Lagonegro units) and map-scale folding of overlying layered talus deposits (Giano et al., 1997a). Overall, transpressional features are related to the existence of a local restraining bend of the left-lateral strike-slip master fault of this side of the valley (Schiattarella et al., 1998).

The folded and tilted talus breccia is well to poorly stratified, and shows clear growth relationships with the fold. The thickness is highly variable and can exceed 20 m in the hinge zone. The breccia is covered by a 2 m thick palaeosoil (Fig. 9), which is in turn cut by a

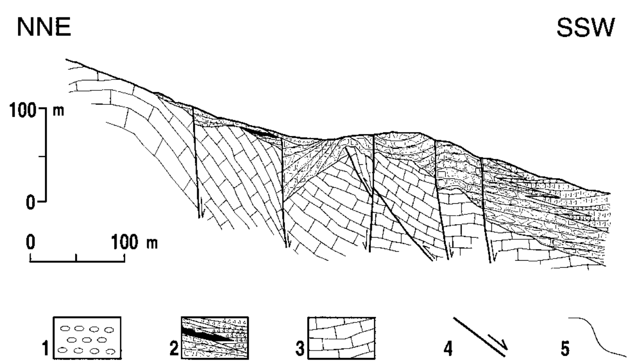

Fig. 8. Geological cross-section of the Galaino area. Legend: (1) Holocene colluvium; (2) Pleistocene coarse-grained slope deposits with interbedded palaeosoil; (3) upper Triassic Calcari con Selce Fm; (4) fault; (5) stratigraphic contact.

Fig. 9. Galaino site (sample PA5): fault plane with striae (see Fig. 5b) in the palaeosoil covered by recent coarse-grained slope deposits.

depositional glacis and by younger, undeformed massive breccias still in depositional contact with the source area upslope (Figs. 8 and 9).

The palaeosoil (sample PA5) is formed by 1 m thick compacted red clay, strongly faulted and striated (Fig. 9). Structural analysis of the faults shearing through the palaeosoil shows both southeasterly dextral transtension and northeast–southwest extension (Fig. 5). The palaeosoil can be followed in outcrop for 15–20 m without appreciable lateral variation in thickness and facies.

Table 1
Age of sampled palaeosoils from the Agri high valley

Sample	Sample description	Laboratory code	Conventional age (1σ)	Calibrated age	$\delta^{13}C$ (‰)
Pergola PA3A	Palaeosoil	R-3119	$18{,}037 \pm 261$	21,898 ÷ 21,152 BP	−23.75
Viggiano PA7	Palaeosoil	R-3121	$31{,}740 \pm 970$	–	−23.18
Galaino PA5	Palaeosoil	R-3124	> 39,600	–	−24.02

5. Sampling and radiocarbon dating

In the Agri high valley the presence of different palaeosoils involved in faulting has allowed for the dating of tectonic events by the use of ^{14}C method.

Radiometric dating has been performed in order to decipher a chronology of deformation and confirm the suspect recent age of displacements in the study area. The dating of faulting has been possible owing to the availability of thick pedogenic units and organic matter effective to the ^{14}C dating (Table 1).

On the basis of (1) quick weathering produced on calcareous breccia (a few hundred years) typical at these latitudes and in a humid climate (Birkeland, 1984), (2) short time of deposition of the pedogenic unit and (3) quick sealing of the overlying talus, we assume the geochemical system closed quite rapidly, avoiding a progressive physical contamination with the external environment. For these reasons, we consider the whole set of dating as representative of the true age of the palaeosoils, which can constrain the age of faulting.

Samples have been collected in seven different outcrops where palaeosoils have been involved in faulting. Only three of them, Pergola (PA3A), Viggiano (PA7), and Galaino (PA5) have yielded reliable results using the ^{14}C methodology; other three samples are currently undergoing AMS dating by ^{14}C radionuclide. The sampling of the palaeosoils has been carried out according to the following steps:

- accurate selection of the exact point of sampling along the pedogenic horizon, in order to avoid the mixture of different layers due to faulting;
- cleaning of the weathered superficial rind above the sampling point;
- deepening along the same decimetric-thick horizon within the palaeosoil;
- sampling of significative volumes of material, as a function of the estimated content in organic matter.

^{14}C measurements were carried out after a long laboratory pretreatment procedure, aimed to extract soil organic matter. After removal of intrusive contaminants (mainly rootlets) the bulk soil, about 0.7 kg in weight, was submitted to chemical pre-treatment using acid–base–acid hydrolysis in several runs.

Finally, the extracted organic matter was dried and burned in a stream of oxygen, in order to obtain CO_2.

The gas derived from the combustion is normally forced through a purification circuit, including CuO at 650°C and solutions of $AgNO_3$ and $MnSO_4$ (Alessio et al., 1970). Additional gas purifications were activated before analyzing the ^{14}C content of the samples.

Radioactivity measurements were carried out by means of CO_2 filled proportional counters (3 atmosphere, 8600 V).

The ^{14}C activity is routinely compared with that of a standard sample derived from the ANU (Australian National University) Sucrose: this sample was checked in 1991 in the context of an international intercalibration proposed by IAEA (International Atomic Energy Agency, 1991). Background level is checked by means of a sample derived from a stock of Carrara (Italy) marble calibrated in the cited intercomparison.

The dating results are shown in Table 1. It must be stressed that only for one sample (R-3119) it is possible to indicate the calibrated age; the conventional ages of the other two samples are older than the present calibration limit (18,360 yr BP; Stuiver and Reimer, 1993).

In this case, in order to discuss the chronology, homogeneous data must be used, i.e. conventional ages; it is well known, however, that conventional ages are different from true ages, the differences depending on the radiocarbon ages themselves. So, one has to take into account that the true age of the sample R-3119 is the calibrated one; for the other samples the differences between true and conventional ages may be estimated in the order of one or two K-years.

All the results for the sample R-3124 are very close to the range of radiocarbon dating (about 40 ka) and the best obtained measurement is >39,600 yr BP. However, every measurement of the sample R-3124 is distinguished from the background, and we attribute the still unresolved result simply to a slow laboratory separation process. Consequently, we are confident that new measurements (currently in progress) will give a more precise date not so far from the 39,600 yr just obtained. Be as it may, the presently available value for sample R-3124 can be applied to as a reliable marker for dating tectonic activity in the Agri high valley.

6. Concluding remarks

The ^{14}C dating of palaeosoils involved in faulting in the Agri high valley has revealed a recent age for the tectonic displacements. The deformation experienced by the youngest continental sediments occurred after 20,000 yr BP and represents a good example of active faulting (sensu Trifonov and Machette, 1993; see also Machette et al., 1998) in the southern Apennines.

The present-day structure of the basin is a consequence of the Quaternary brittle tectonics acting along NW–SE striking faults which cut the N–S trending structures of the fold-and-thrust belt. Two different Quaternary tectonic stages were recognized (Giano et al., 1997a; Schiattarella et al., 1998). The first, lower Pleistocene in age, was characterized by strike-slip along the N120° trending master faults, which also produced the gentle folding of the Galaino breccias. The well-known N120° trending left-lateral strike-slip faults are spread along a wide axial portion of the southern Apennines (Schiattarella, 1998). The second stage took place since middle Pleistocene as a consequence of an extensional regime on a regional scale with a NE–SW tensional axis (Schiattarella, 1998). NE–SW directed extension reactivated the pre-existing structural pattern with different kinematics. A similar two-step tectonic evolution is proposed for the same time span also in many other basins of southern Italy (see for example Schiattarella et al., 1994, for the Mercure lacustrine basin at the Calabria–Lucania boundary), even if the role of the inherited structures in the Agri high valley makes the Quaternary deformational pattern more intricate, often controlling location and geometry of the faults. Anyway, it seems likely that a NE–SW extension is the present-day active deformation.

Radiocarbon dating of three samples from palaeosoils involved in faulting has yielded chronological constraints on the widely documented tectonic activity of the area. The distribution not only of the dated samples, but also of several still undated faulted palaeosoils, clearly suggests a recent and possibly ongoing tectonic activity for the whole perimeter of the basin and for adjacent structural depressions. This supports the idea of a long nesting of faulting in the basin since its inception in early Pleistocene times (Schiattarella et al., 1998). The obtained radiometric ages span the 40–20 ka interval and are close to the end of the Pleistocene. This interval has already been recognized (see for example Ferranti et al., 1997) as a moment of strong renewal of extensional tectonic activity in the southern Apennines, as also testified by coeval volcanism along the Tyrrhenian side of the chain.

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