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Between Tevere and Arno. A preliminary revision of seismicity in the Casentino-Sansepolcro (Tuscany, Italy) area

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"An ill-favoured thing sir, but mine own."
(Wm. Shakespeare, As You Like It, Act V, Sc. 4)

Abstract - According to the current Italian catalogue only a few minor earthquakes are located in the Tuscan portion of the Apennines lying between the seismogenic areas of Mugello (north) and Upper Valtiberina (south) and roughly corresponding to the historical district of Casentino. The existence of a seismic gap in this area has been conjectured but, as there is no definite geological explanation for a lack of energy release, the gap could also be an information one, due either to a lack of sources recording past earthquakes or even to a lack of previous seismological studies specifically dealing with the Casentino. A preliminary historical investigation improves the perception of local seismicity by recovering the memory of a few long-forgotten earthquakes.

1. Introduction

The Casentino is a historical Tuscan district defined by the upper courses of the rivers Arno and Tevere; it includes a wide valley, through which the Arno flows in its earliest tract and which is bordered westward by the Pratomagno hill range and eastward by a section of the Apennines chain reaching southward to Sansepolcro and the Upper Valtiberina (Fig. 1). Though the Casentino lies between two well-known seismogenic areas (Mugello and Upper Valtiberina) no important earthquakes are located there according to the current Italian catalogue (Gruppo di Lavoro CPTI, 1999); the area is believed to be an obscure trait of the so-called Etrurian Fault System (Lavecchia et al., 2000) and the existence of a Casentino seismic gap was also

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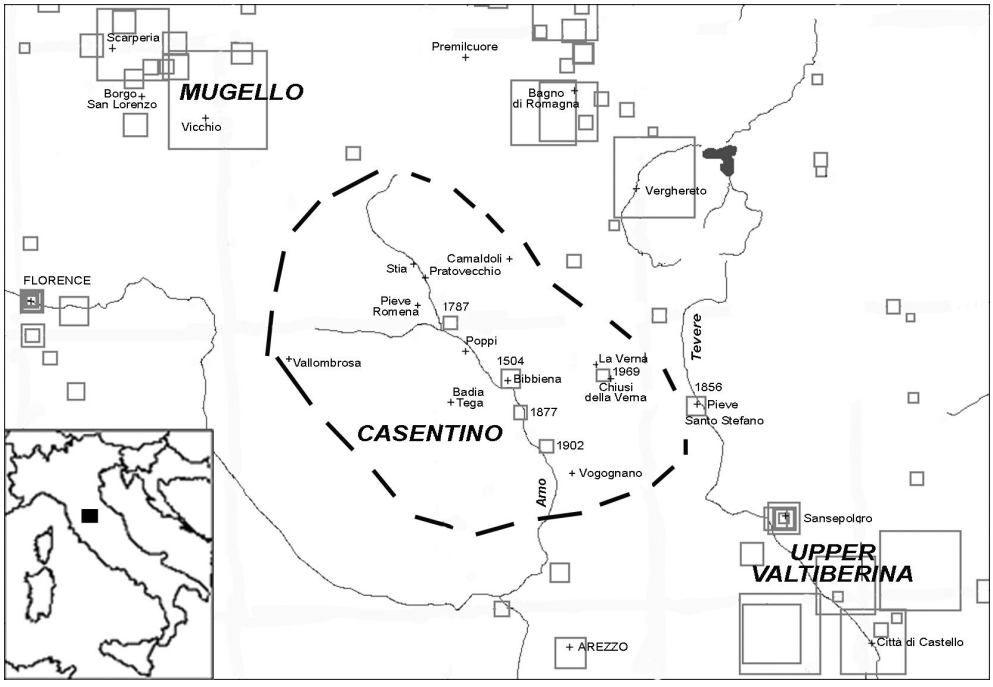

Fig. 1 - The studied area and its seismicity before this study. Within broken lines: Casentino historical district. Grey squares: historical seismicity from Gruppo di Lavoro CPTI (1999); squares' proportions vary according to earthquake magnitude.

conjectured. However, there is no ready-made geological explanation to support this conjecture and scarcity of earthquakes could result from an information gap as well as from a seismic one, that is either from a lack of historical sources giving evidence of past local events (seismic or otherwise) or, even more simply, from a lack of previous studies of local seismicity.

Over the past centuries the Casentino, like many other European mountainous regions (the Alps, the Pyrenees, the Scottish Highlands, ...), was to some extent an inward-looking microcosm with a culture of its own, but it was never so introverted, unlettered or uninteresting to be unable to produce historical records of its own or to stimulate outside observers to produce records dealing with it. As the seat of two great religious orders (the Camaldolites and Vallombrosian Benedictines), a leading medieval feudal family (the Guidi), a much-frequented Franciscan shrine (La Verna), and also a subject of interest for travellers and travel writers at least from 16th century (Brilli, 1993), the Casentino has quite a good historical record, better by far than many other mountain districts of central and southern Italy (Wickham, 1988). On the other hand, the Casentino was never a subject of interest either for the erudite 17th -19th century Italian earthquake-list compilers or for the large-scale historical earthquake studies launched in Italy from the 1980's onward. The information collected in 17th -19th century erudite earthquake compilations, later revised, corrected and fleshed out by the results of modern studies, does still form the backbone of current Italian earthquake consciousness. Therefore, no conclusions can really be drawn on the historical seismicity of the Casentino (or the lack thereof) unless a specific study is made.

2. A preliminary historical investigation of the Casentino seismicity

In the autumn of 2001 a preliminary historical research of the Casentino seismicity was launched with the aim of updating and improving what little information was available. The current Italian catalogue (Gruppo di Lavoro CPTI, 1999) lists 2480 earthquakes in the time-window from 217 B.C. to 1992. For 1018 of them, earthquake parameters were derived from macroseismic intensity data provided by recent studies; in the residual 1462 cases, no studies or macroseismic intensity data being available, the parameters were taken from previous parametric catalogues. As three out of five known Casentino earthquakes (Table 1) fall into the latter category, the first task to tackle was finding evidence of their effects in order to draft their intensity maps. At the same time evidence of local historical earthquakes unknown to seismological literature (if any) was sought. This research was not restricted to a preselected time-window but aimed at extracting as much evidence as possible from a preselected set of repertories. Given its preliminary character, the research was primarily based on bibliographical material, carefully chosen on account of its relevance for the area. The set of repertories included: descriptive earthquake compilations (some of whom had never been previously considered by seismological studies), standard reference works (among them Targioni Tozzetti, 1751-1754; Mittarelli and Costadoni, 1755-1773; Pietro Leopoldo, 18th c.; Repetti, 1835-1841; Prezzolini, 1859; Beni, 1889, 1908) and a selection of primary sources (chronicles, private diaries and early gazettes). In a few particularly promising cases, the bibliographical study branched out in a search for unpublished archive documents.

Some evidence of earthquakes unknown to seismological literature was found. In a few cases it concerned damaging events and was detailed enough to allow to locate them with a modicum of reliability; often, however, it was no more than a report of earthquake shocks being felt at a site on a given date, from which no reliable epicentral location could be derived. In these cases the information was filed as an input for further research. Finally, in a few cases, a careful scrutiny of the evidence collected has shown it to be related to fictitious earthquakes. These findings have also been filed for reference, to ensure that such fallacious evidence will not be taken at face value in the future. Whenever possible, intensity data points were derived from the collected macroseismic evidence and new epicentral parameters were obtained with the BOXER algorithm (Gasperini et al. 1999), a method especially designed to assess the location, physical dimensions and orientation of historical earthquake sources from macroseismic intensity data.

Table 1 - Casentino earthquakes (from Gruppo di Lavoro CPTI, 1999). Np indicates the number of felt intensities.

Year	M	D	Epic. area	Np	Lat. N	Lon. E	Io MCS	M
1504	11	01	Bibbiena	1	43.696	11.816	VI-VII	4.6
1787	12	26	Bibbiena		43.750	11.750	VI	4.3
1877	03	03	Chiusa Verna		43.667	11.833	VI	4.3
1902	06	27	Casentino	21	43.642	11.856	VI	4.3
1969	08	09	Chiusa Verna		43.700	11.933	VI	4.1

3. Earthquakes in Casentino: an update

The seismicity of Casentino, as summed up in the CPTI catalogue (Gruppo di Lavoro CPTI, 1999) (Table 1), amounts to a handful of mildly damaging events located, with one exception (1969), in the southernmost part of the district. Only two of them (1504 and 1902) were studied recently. The 1504 earthquake was in fact studied twice, by Postpischl (1990), whose parameters were adopted by the CPTI catalogue, and by Boschi et al. (1997), slightly more advanced than the former from the viewpoint of actual archive research, but reaching similar conclusions. Another three events had never been studied before, the CPTI catalogue having inherited their parameters from the Postpischl (1985) catalogue, that in turn assessed them from the evidence made available by the Baratta (1901) Italian earthquake compilation. Macroseismic evidence for the 1787 event in Poppi (central Casentino) and surroundings was collected from early gazettes (Gazzetta universale, 1787, 1788). The 1877 event was found to have been mistakenly located in Casentino by Postpischl (1985), whose source (Baratta, 1901) describes in fact an event that affected the area southeast of Florence. Finally, a preliminary intensity map for the 1969 event was derived from Gasparini (1974).

The perusal of a large set of seismological compilations and standard historical reference works led to discover a few late 19th century recordings of earthquake shocks in Camaldoli, tucked away in remote corners of Baratta (1901) and overlooked by Postpischl (1985) and at least two damaging earthquakes (1599 and 1729), both credited with causing significant damage in Romena (northern Casentino).

Romena (now Pieve Romena), the main medieval seat of the Guidi family, was in its heyday a small walled and towered settlement including a keep ("*cassero*"), a palace, dwellings for some scores of families and a hospital for travellers and, outside the enclosure, the Romanesque baptismal church of St. Peter, one of the foremost Casentino monuments. On 16 November 1599 "*an earthquake greatly damaged many houses in Romena and elsewhere. Part of the hospital collapsed and its church was cracked open* [...] *the nave of St Peter's was fissured and the ciborium arch crashed down*" (Fraticelli, 1860; Beni, 1889). This description was penned on the end-page of a book of Statutes of a local lay confraternity. Sometime before 1860 the volume (whose present whereabouts is unknown) was bought in Stia (Casentino) by Capt. Brooke, a British collector. The new owner allowed the earthquake memoir to be transcribed by Pietro Fraticelli, who afterwards published it in a footnote to his edition of Dante's Divine Comedy (Fraticelli, 1860) on account of its relevance for the interpretation of verses Inf., XXX, 76-78.

The 1729 earthquake, located in Florence (Io VI MCS; M 4.3) by the CPTI catalogue, is depicted by classical earthquake compilations as a Florentine earthquake (Giovannozzi, 1895), but Florentine primary sources point out that the actual damage was quite slight in Florence (ASV, 1729) though the recurrence of aftershocks for some days after 23 June caused great panic to the citizens (Settimanni, 18th c.). It appears, however, that "*the dwellers of Casentino also experienced all the strength of this earthquake*" (Giuntini, 1729). Baratta (1901) adds that the Casentino site most affected was Pratovecchio, without quoting the source of this information or giving any more details. Now, Pratovecchio is very close to Romena where,

Table 2 - MCS intensity values assessed for Casentino earthquakes by this study.

Year	M	D	Locality	Lat. N	Lon. E	I MCS
1504	11	01	Bibbiena	43.696	11.816	VI-VII
1504	11	01	Arezzo	43.463	11.879	IV-V
1599	11	16	Pieve Romena	43.774	11.716	VII-VIII
1599	11	16	Firenze	43.777	11.249	V
1729	06	23	Pieve Romena	43.774	11.716	VII-VIII
1729	06	23	Firenze	43.777	11.249	VI
1729	06	23	Pratovecchio	43.788	11.722	V-VI
1729	06	23	Signa	43.781	11.097	V-VI
1729	06	23	Pistoia	43.932	10.913	III-IV
1787	12	26	Poppi	43.723	11.767	VI-VII
1787	12	26	Siena	43.321	11.328	IV
1787	12	26	Firenze	43.777	11.249	III-IV
1823	11	23	Bibbiena	43.696	11.816	V
1823	11	23	Poppi	43.723	11.767	V
1823	11	23	Pratovecchio	43.788	11.722	V
1823	11	23	Stia	43.800	11.708	V
1823	11	23	Subbiano	43.575	11.870	V
1823	11	23	Arezzo	43.463	11.879	IV
1823	11	23	Firenze	43.777	11.249	IV
1895	06	19	Camaldoli	43.793	11.821	V
1898	02	09	Camaldoli	43.793	11.821	V
1969	08	09	Chiusi d Verna	43.695	11.939	VI
1969	08	09	Caprese Michelangelo	43.641	11.985	V
1969	08	09	Verghereto	43.793	12.005	V
1969	08	09	Bagno di Romagna	43.834	11.960	V
1969	08	09	Camaldoli	43.793	11.821	V
1969	08	09	Pieve Santo Stefano	43.670	12.041	IV
1969	08	09	Poggio d Acona	43.633	11.875	IV
1969	08	09	Pratovecchio	43.788	11.722	IV
1969	08	09	Sarsina	43.918	12.143	IV
1969	08	09	Stia	43.800	11.708	IV
1969	08	09	Anghiari	43.540	12.054	III
1969	08	09	Arezzo	43.463	11.879	III
1969	08	09	Loro Ciuffenna	43.592	11.632	III
1969	08	09	Pennabilli	43.816	12.264	III
1969	08	09	Pergine Valdarno	43.469	11.686	III
1969	08	09	Pomino	43.816	11.551	III
1969	08	09	Talla	43.601	11.789	III

Table 3 - Casentino earthquakes after this study. Np indicates the number of felt intensities.

Year	M	D	Epic. area	Np	Lat. N	Lon. E	Io MCS	M
1504	11	01	Bibbiena	2	43.696	11.816	VI-VII	4.7
1599	11	16	Pieve Romena	2	43.774	11.716	VI-VII	5.1
1729	06	23	Pieve Romena	5	43.776	11.482	VI-VII	5.1
1787	12	26	Poppi	1	43.723	11.767	VI-VII	4.7
1823	11	23	Casentino	7	43.736	11.768	V	4.3
1895	06	19	Camaldoli	1	43.793	11.821	V	4.6
1898	02	09	Camaldoli	1	43.793	11.961	V	4.2
1902	06	27	Casentino	21	43.642	11.856	VI	4.3
1969	08	09	Chiusa Verna	17	43.760	11.961	V	4.2

according to Repetti (1835-1841) and Beni (1889), an earthquake damaged the facade and belfry of the church of St. Peter's and caused a few buildings within the walled enclosure to collapse in 1729. Further investigation pending, it seems likely that the above evidence was related to one and the same earthquake. Table 2 shows the intensity values assessed for Casentino earthquakes by this study and Table 3 lists their epicentral parameters.

4. Fictitious Casentino earthquakes

Table 4 lists some events described as earthquakes by standard reference works on Casentino. The related evidence was carefully examined and found to be trumped up or mistaken. As some of these fictitious earthquakes are still mentioned as real ones by modern guidebooks and websites, it is worthwhile to record the procedure and reasoning by which they were found to be false.

4.1. Selvamonda Abbey (near Badia a Tega, central Casentino) event of 1426

Farulli (1717), a standard history of Arezzo, affirms that in 1426 the Abbey of Selvamonda (near Badia a Tega, central Casentino, Wickham, 1988) was destroyed by an earthquake. The holy relics owned by the abbey were recovered from the shambles and sent for safekeeping to Florence, where the city lord Cosimo de' Medici had a bronze casket made for them by Lorenzo Ghiberti (Farulli, 1717, pp. 220-221). This tale mixes facts and fantasy. The Selvamonda Abbey had indeed been badly managed for most of 14th century and by 1422 it was so run down that pope Martin V decided to put it under the control of the Camaldolite monastery of Florence (Richa, 1759). To stress this decision, on 29 January 1422, he issued a bull ordering the holy relics owned by Selvamonda Abbey to be sent for safekeeping to Florence. Here in due course, between 1427 and 1428, a casket (extant, in the Museo Nazionale del Bargello, Florence) was made for them by Ghiberti (Krautheimer, 1970; Lapi, 1978). The January 1422 bull (published in Mittarelli and Costadoni, 1755-1773, vol. VI, app., cols. 287; 754) does not mention any earthquake. Far from having been destroyed, either in 1422 or 1426, the Abbey of Selvamonda was still operating in 1434-1435, when its abbot had to be replaced after being found guilty of adultery and attempted murder of his mistress' husband (Traversari, 15th c.).

Table 4 - Fictitious Casentino earthquakes identified by this study.

Year	M	D	Locality	Source
1426			Selvamonda abbey (near Badia Tega)	Farulli (1717)
1433			S. Giovanni del Sasso abbey (near Vogognano)	Farulli (1717)
1579			Pieve Romena	Beni (1908)
1597	11	16	Pieve Romena	Baratta (1899)
1678	11		Pieve Romena	Beni (1908)

4.2. Abbey of the Sasso (near Vogognano, southern Casentino) event of 1433

In 1433, again it is Farulli (1717) that tells this tale, the Abbey of San Giovanni Battista del Sasso (near Vogognano, southern Casentino, Giusti and Guidi, 1932-1942) was destroyed by an earthquake. Pope Eugenius IV was instead, and wrongly, told that the abbey had been allowed to collapse for lack of maintenance by the Camaldolites of Florence, in whose keeping it had been for some years. The pope then took the abbey away from the Camaldolites and appointed another caretaker for it (and its property), but he went back on his decision after the archbishop of Florence told him that an earthquake had really been responsible for the destruction (Farulli, 1717, p. 219).

Just like the Selvamonda episode, this tale too is an inaccurate and misleading mix of fact and surmise. The original papal records on the affair (published in Mittarelli and Costadoni, 1755-1773, vol. VII, app., cols. 94-99) show that it was Nicholas V in 1451 (rather than Eugenius IV in 1433) who revoked the Camaldolite stewardship of the Abbey of Sasso for having neglected and deserted it. He later reversed his decision after the archbishop of Florence and other worthies had testified that the abbey's decay was due to "*its antiquity and the malice of (lay)men*" rather than to bad management. None of the original sources involved mentions any earthquake in connection with this episode.

4.3. Romena (northern Casentino) events of "1579", "16 November 1597" and "November 1678"

Beni (1908) gives a list of "*telluric movements that damaged the castle (of Romena)*" including a "*1579*" earthquake and a "*November 1678*" one, charged with causing the collapse of the facade of the church of St Peter's. The former's date is clearly a misprint for "*1599*" (see above); the latter - a real enough event - was in fact a landslide caused by heavy rainfall. Thus Repetti (1835-1841) quoting a contemporary memoir "*written in a book of the suppressed parish of San Bartolomeo a Strapetognoli*" by parish priest Angelo Ciapetti. Beni, who certainly knew Repetti's work, was not deliberately misleading when he called the event a "*moto tellurico*", as this expression applies to landslides as well as to earthquakes. However, the popular Italian usage of today tends to use the adjective "*telluric*" in a restrictive way, as a synonim of "*seismic*". This could be the reason why the event of 1678 features as an earthquake on the Internet website htpp://www.casentino.it, alongside the equally fictional event of 1579.

Another misprint was probably responsible for the listing of a 16 November 1597 Romena earthquake by Baratta (1899), whose source, Fraticelli (1860), describes in fact the earthquake of 16 November 1599 (see above).

5. On the fringes of Casentino: earthquakes in the Pieve Santo Stefano/Sansepolcro area

The southeasternmost corner of Casentino dwindles into a strip of hilly country edged by the Arno and Tevere riverbeds and gradually sloping down towards Sansepolcro and the Upper

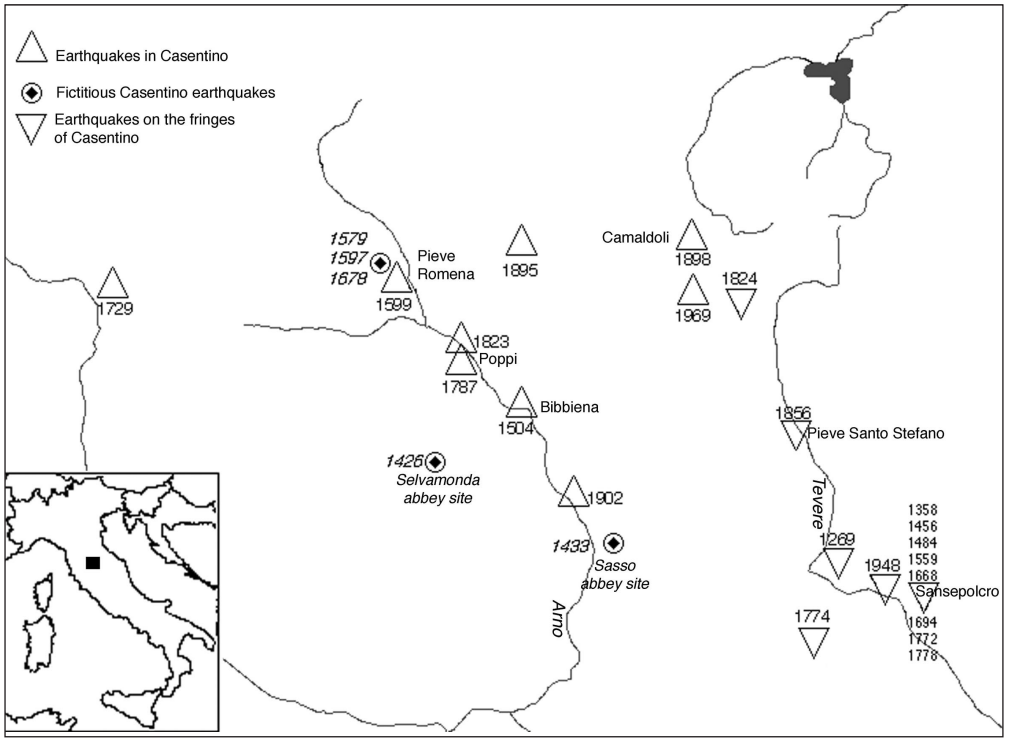

Fig. 2 - The studied area and its seismicity after this study.

Valtiberina plain. Evidence of local seismic activity here, if any, must necessarily be intermingled with, if not actually concealed by, evidence pertaining to the seismicity of the Upper Valtiberina proper.

The historical seismic record of Upper Valtiberina is comparatively well known from 14th century onward and includes several strong earthquakes, from contemporary information which is often plentiful, though mostly restricted, at least up to the late 18th century, to descriptions of effects in the two chief Valtiberina towns (Sansepolcro and Città di Castello) and sometimes even in one locality only. Table 5 lists the earthquakes for which only macroseismic data for Sansepolcro (or in a couple of cases Pieve Santo Stefano, a few kilometres north of Sansepolcro) are available. This situation is puzzling, on account of the short distance

Table 5 - Earthquakes in the Pieve Santo Stefano/Sansepolcro area (Gruppo di Lavoro CPTI, 1999). Np indicates the number of felt intensities.

Year	M	D	Epic. area	Np	Lat. N	Lon. E	Io MCS	M
1270			Sansepolcro	1	43.570	12.141	VII-VIII	5.1
1358			Sansepolcro	1	43.570	12.141	VI-VII	4.6
1456	12	09	Sansepolcro	1	43.570	12.141	V-VI	4.0
1489			Sansepolcro	1	43.570	12.141	VII	4.8
1694	04	08	Sansepolcro	1	43.570	12.141	VII	4.8
1824	08	12	Pieve S Stefano		43.75	12.000	VI	4.3
1856	06	05	Pieve S Stefano	2	43.670	12.041	VI-VII	4.6

separating Sansepolcro from Città di Castello (little more than twenty kilometres) and also because at least some of these events (1358, 1456) occurred within a few years from other events for which damage is on record not only in Sansepolcro but in Città di Castello as well (which could imply, for instance, that the latter did not suffer from a shortage of sources able to record earthquakes at the time). Short of liquidating all Table 5 earthquakes as fictitious ones [in fact the related evidence seems reliable enough, with the possible exception of the 1484 event, listed by the current catalogue as "*1489*" and based on the questionable authority of Farulli (1713)], another possible explanation is that the potential Città di Castello earthquake recorders failed to react to these earthquakes because their effects were not relevant enough, locally, to be worth recording. As very primitive "seismographs" are implied here, this could mean that they caused only slight, occasional damage or no damage at all in Città di Castello.

As recent experience shows, such situations do happen. The 26 November 2001 earthquake (INGV, 2001), preliminarily located in Casentino with M_s = 4.4 and at a depth of 6 kilometres (assessed from instrumental data) caused its most severe effects (VI-VII MCS) in Aboca and other small settlements in the hills north of Sansepolcro, extremely circumscribed damage in Sansepolcro and none in Città di Castello (Corriere di Arezzo, 2001; La Nazione, 2001). The earthquake of 13 June 1948 (Boschi et al., 1997), located in Sansepolcro, with M_s = 4.8, caused higher damage (VII MCS) in Aboca and Sansepolcro than in Città di Castello (VI MCS), the severity of effects possibly having been influenced in this case by the increased vulnerability of buildings that had been subjected to heavy bombing during World War II (Morton, 1964).

This study improved the data sets of some earthquakes listed in Table 5 by retrieving enough original records for the 1694 (ASCSS, 1692-1708, 1708-1722; ASMO, 1694) and 1948 earthquakes (AUCMGRM, 1948) to vouchsafe the preparation of new intensity tables for both events. A few earthquakes, unknown to seismological literature and displaying a pattern of damage distribution consistent with those of the 1948 and 2001 earthquakes (if much sparser) were also discovered (Tables 6 and 7). The earliest of these events occurred some time before 17 June 1269 and caused the Abbey of St. Bartolomeo a Sucastelli (between Sansepolcro and Pieve Santo Stefano) to be "*destroyed and laid waste*" (ADCC, 1269; Bercordati, 16th c.; Czortek, 1998); further research should explore the possibility of a connection between this event and the 1270 earthquake (Table 5), described as severely damaging to Sansepolcro by a contemporary and reliable, but not local source (Tolomeo da Lucca, 13th c.), whose reckoning could be faulty or that could have referred to Sansepolcro a damage scenario pertaining in fact to the countryside north of Sansepolcro.

The 11 April 1559 earthquake is a controversial one. It certainly caused some damage in Sansepolcro, as a contemporary official source mentions some 200 chimneypots tumbled down (ASCSS, 1557-1562), while a private diary describes the collapse of "*houses, roofs and chimneys*" (Alberti, 16th c.). However no contemporary descriptions of macroseismic effects in the nearby countryside are available. Only a much later source (Pignani, 18th c.) gives a rather garbled and unsubstantiated story about a 23 August (sic) 1559 earthquake purported to have caused "*the ruin of many country houses*".

In 1731, a long sequel of strong and frequent shocks affected Pieve Santo Stefano and surroundings from 11 March to 14 April (ASV, 1731a; Mantova, 1731a), culminating on 29

Table 6 - Earthquakes in the Pieve Santo Stefano/Sansepolcro area (this study). Np indicates the number of felt intensities.

Year	M	D	Epic. area	Np	Lat. N	Lon. E	Io MCS	M
1269	06	17	Badia Sucastelli	1	43.593	12.073	VII-VIII	5.5
1270			Sansepolcro	1	43.570	12.141	VII-VIII	5.1
1358			Sansepolcro	1	43.570	12.141	VI-VII	4.6
1456	12	09	Sansepolcro	1	43.570	12.141	V-VI	4.0
1484			Sansepolcro	1	43.570	12.141	VII	5.3
1559	04	11	Sansepolcro	1	43.570	12.141	VII	5.3
1668	08	22	Sansepolcro	1	43.570	12.141	V	4.6
1694	04	08	Sansepolcro	5	43.570	12.141	VII-VIII	5.5
1731	03	11	Pieve S. Stefano	1	43.570	12.141	VII-VIII	5.5
1772	10	12	Sansepolcro	1	43.570	12.141	VI	4.9
1774	01	31	Acquitrina	3	43.546	12.050	V-VI	4.7
1778	08	03	Sansepolcro	1	43.570	12.141	VI	4.9
1823	05	31	Sansepolcro	1	43.570	12.141	IV-V	4.4
1824	03	16	Sansepolcro	1	43.570	12.141	V	4.6
1824	08	12	Pieve S. Stefano		43.75	12.000	VI	4.3
1856	06	05	Pieve S. Stefano	2	43.670	12.041	VI-VII	4.6
1868	01	31	Sansepolcro	1	43.570	12.141	IV-V	4.4
1948	06	13	Sansepolcro	79	43.576	12.110	VI-VII	4.9

March in an event that "*threw many houses to the ground*" (Settimanni, 18th c.) but did not cause human loss as the population had already left the houses some days before (ASV, 1731b; Mantova, 1731b; Sacchi, 19th c.). More aftershocks followed till 14 April, when seven shocks at least were felt, before the sequence ended for good (ASV, 1731c; Piccardini, 1886). This earthquake left a very strong mark on local memory and to this day the community of Pieve Santo Stefano does still keep a vow made in 1731, by celebrating a yearly ceremony of thanksgiving and remembrance. This is all the more significant as the memory of the 1731 earthquake was not effaced by either of the major disasters that in subsequent centuries befell the town (which would be destroyed twice, by a flood in the mid-19th century and by bombs during World War II).

The earthquake of 31 January 1774 caused at least one house to collapse in Acquitrina (a hamlet a few kilometres north of Sansepolcro) and its shocks were strongly felt as far as Arezzo (Gazzetta Universale, 1774). From evidence available it is not clear whether Sansepolcro was damaged too, though it is on record that prayers "*to be delivered from the earthquakes*" were publicly offered there (Gazzetta Toscana, 1774): the use of the plural form could hint at a longer seismic period than would appear from the meagre report available in the Gazzetta Universale (1774).

6. A few final considerations

A preliminary examination of the historical seismic record of Casentino was carried out, the quality of the available information was checked and additional information on the effects of a few earthquakes previously unknown to any parametric earthquake catalogue was retrieved. It is likely that these results can be further improved by deeper delving into judiciously selected

Table 7 - Intensity values assessed for the earthquakes of Table 6 by this study. HD means heavy damage.

Year	M	D	Locality	Lat. N	Lon. E	I MCS
<1269	06	17	Badia Sucastelli	43.593	12.073	VII-VIII
<1270			Sansepolcro	43.570	12.141	VII-VIII
<1358			Sansepolcro	43.570	12.141	VI-VII
<1456	12	09	Sansepolcro	43.570	12.141	V-VI
<1484			Sansepolcro	43.570	12.141	VII
<1559	04	11	Sansepolcro	43.570	12.141	VII
<1559	04	11	Sansepolcro area			HD
<1668	08	22	Sansepolcro	43.570	12.141	V
<1694	04	08	Sansepolcro	43.570	12.141	HD
<1694	04	08	Città di Castello	43.456	12.239	V
<1694	04	08	Monterchi	43.485	12.111	III-IV
<1694	04	08	Pesaro	43.904	12.905	V
<1694	04	08	Pieve S Stefano	43.670	12.041	VII-VIII
<1694	04	08	Sansepolcro	43.570	12.141	VII
<1731	03	11	Pieve S Stefano	43.670	12.041	VII-VIII
<1772	10	12	Sansepolcro	43.570	12.141	VI
<1774	01	31	Acquitrina	43.605	12.131	VI-VII
<1774	01	31	Arezzo	43.463	11.879	V
<1774	01	31	Sansepolcro	43.570	12.141	V
<1778	08	03	Sansepolcro	43.570	12.141	VI
<1823	05	31	Sansepolcro	43.570	12.141	IV-V
<1824	03	04	Pieve S Stefano	43.670	12.041	IV
<1824	03	16	Sansepolcro	43.570	12.141	V
<1824	08	12	Pieve S Stefano	43.670	12.041	VI
<1856	06	05	Pieve S Stefano	43.670	12.041	VI-VII
<1856	06	05	Sansepolcro	43.570	12.141	IV-V
<1856	06	05	Urbino	43.726	12.636	IV-V
<1856	06	25	Pieve S Stefano	43.670	12.041	V-VI
<1856	06	25	Sansepolcro	43.570	12.141	IV-V
<1868	01	31	Sansepolcro	43.570	12.141	IV-V
<1948	06	13	Aboca	12.123	43.626	VI-VII
<1948	06	13	Cignano	12.116	43.598	VI-VII
<1948	06	13	Pieve S Stefano	12.041	43.670	VI-VII
<1948	06	13	San Giustino	12.174	43.549	VI-VII
<1948	06	13	Sansepolcro	12.141	43.570	VI-VII
<1948	06	13	Anghiari	12.054	43.540	VI
<1948	06	13	Citerna	12.116	43.498	VI
<1948	06	13	Apecchio	12.420	43.558	V-VI
<1948	06	13	Cagli	12.651	43.546	V-VI
<1948	06	13	Caprese Michelangelo	11.985	43.641	V-VI
<1948	06	13	Casteldelci	12.155	43.791	V-VI
<1948	06	13	Chiusi della Verna	11.939	43.695	V-VI
<1948	06	13	Città di Castello	12.239	43.456	V-VI
<1948	06	13	Mercatello sul Metauro	12.337	43.647	V-VI
<1948	06	13	Piandimeleto	12.414	43.724	V-VI
<1948	06	13	Arezzo	11.879	43.463	V
<1948	06	13	Borgopace	12.294	43.658	V
<1948	06	13	Chitignano	11.881	43.660	V
<1948	06	13	Monte S Maria Tiberina	12.162	43.437	V
<1948	06	13	Monterchi	12.111	43.485	V
<1948	06	13	Sant'Agata Feltria	12.209	43.864	V
<1948	06	13	Sassocorvaro	12.496	43.780	V
<1948	06	13	Badia Tedalda	12.187	43.707	IV-V
<1948	06	13	Capolona	11.859	43.562	IV-V
<1948	06	13	Laterina	11.716	43.580	IV-V

Table 7 - continued.

Year	M	D	Locality	Lat. N	Lon. E	I MCS
1948	06	13	Lucignano	11.746	43.273	IV-V
1948	06	13	Montevarchi	11.568	43.523	IV-V
1948	06	13	Montone	12.327	43.363	IV-V
1948	06	13	Sestino	12.297	43.708	IV-V
1948	06	13	Castiglion Fibocchi	11.763	43.527	IV
1948	06	13	Castiglion Fiorentino	11.923	43.341	IV
1948	06	13	Cortona	11.986	43.274	IV
1948	06	13	Foiano della Chiana	11.819	43.252	IV
1948	06	13	Monte Cerignone	12.413	43.840	IV
1948	06	13	Sigillo	12.741	43.331	IV
1948	06	13	Subbiano	11.870	43.575	IV
1948	06	13	Terranuova Bracciolini	11.586	43.55	IV
1948	06	13	Tuoro sul Trasimeno	12.071	43.208	IV
1948	06	13	Urbania	12.523	43.668	IV
1948	06	13	Bibbiena	11.816	43.696	III-IV
1948	06	13	Carpegna	12.336	43.781	III-IV
1948	06	13	Civitella V di Chiana	11.723	43.418	III-IV
1948	06	13	Costacciaro	12.712	43.358	III-IV
1948	06	13	Deruta	12.419	42.982	III-IV
1948	06	13	Frontone	12.734	43.513	III-IV
1948	06	13	Gubbio	12.577	43.351	III-IV
1948	06	13	Lunano	12.440	43.728	III-IV
1948	06	13	Magione	12.206	43.141	III-IV
1948	06	13	Massa Martana	12.525	42.775	III-IV
1948	06	13	Mombaroccio	12.855	43.795	III-IV
1948	06	13	Mondavio	12.969	43.674	III-IV
1948	06	13	Montecalvo in Foglia	12.632	43.811	III-IV
1948	06	13	Ortignano	11.747	43.679	III-IV
1948	06	13	Perugia	12.386	43.106	III-IV
1948	06	13	Piagge	12.969	43.732	III-IV
1948	06	13	Pietralunga	12.436	43.442	III-IV
1948	06	13	Piobbico	12.511	43.589	III-IV
1948	06	13	San Giovanni Valdarno	11.530	43.564	III-IV
1948	06	13	Sant'Angelo in Vado	12.411	43.664	III-IV
1948	06	13	Sarteano	11.869	42.989	III-IV
1948	06	13	Torgiano	12.435	43.025	III-IV
1948	06	13	Castelfranco di Sopra	11.555	43.621	III
1948	06	13	Castiglione del Lago	12.051	43.126	III
1948	06	13	Firenze	11.249	43.777	III
1948	06	13	Marciano della Chiana	11.787	43.304	III
1948	06	13	Siena	11.328	43.321	III
1948	06	13	Cavriglia	11.489	43.521	II-III
1948	06	13	Colbordolo	12.723	43.820	II-III
1948	06	13	Marsciano	12.338	42.909	II-III
1948	06	13	Monte San Savino	11.725	43.331	II-III
1948	06	13	Montelabbate	12.789	43.848	II-III
1948	06	13	Paciano	12.070	43.022	II-III
1948	06	13	Piegaro	12.086	42.969	II-III
1948	06	13	Talla	11.789	43.601	II-III
1948	06	13	Umbertide	12.331	43.304	II-III
1948	06	13	Pergine Valdarno	11.686	43.469	II
1948	06	13	Pergola	12.837	43.563	II
1948	06	13	Pratovecchio	11.722	43.788	II
1948	06	13	Saltara	12.897	43.753	II

archives but, even in their present intermediate state, they allow a more rounded off picture of Casentino seismicity to be drawn than would have been possible before this study. There is now evidence of several minor and some moderately damaging events, whose macroseismic effects are distributed along the whole Casentino area, from Pieve Romena in the north (where, before this study, there was no evidence of seismic activity at all) to the central Poppi and Bibbiena area and the southeastern area reaching to Pieve Santo Stefano and Sansepolcro. For the latter, before this study, some doubtful evidence of events purported to have affected only the site of Sansepolcro was available. The finding of more such evidence and a comparison with some 20th century events' information leads to hypothesize that the occurrence of shallow and extremely localised earthquakes could be a recurring feature of seismic activity in the tiny portion of the Apennines lying between Pieve Santo Stefano and Sansepolcro.

In conclusion, a quick but careful analysis of the historical seismic record of the Casentino leads to believe that the hypothesis of the occurrence of a "seismic gap" in this area can be safely discarded.

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