Table S1. Overview of surface geology, morphological features, structural damage assessment, and estimated PGA for all visited municipalitie S.**Municipality (sequence number)**	**Hamlet**	**Geological setting**	**Slope instability**	**Topographic features**	**Type Structure**	**Damage level after August event**	**Damage level after October events**	**Estimated PGA (g)**		
								M6.1 24 August	**M5.9 26 October**	**M6.5 30 October**
Accumoli (1)	Main village	Laga Formation. Turbidite deposits. Arenaceous lithofacies.Upper Miocene [1]	yes	ridge	masonry	D2-D3	D4-D5	0.54	0.07	0.41
	Fonte del Campo	Quaternary continental deposits. Debris flow and colluvial deposits on terraced alluvial deposits. Upper Pleistocene-Holocene [1]	no	slope	masonry	D3-D4	-	0.57	0.07	0.40
Amatrice (2)	historic center (red zone)	Quaternary continental deposits. Fluvial and alluvial fan deposits (conglomerates, gravels, sands). Early-Middle Pleistocene [2]	no	ridge	masonry	D4-D5	D4-D5	0.62	0.08	0.46
	suburb	Quaternary continental deposits. Fluvial and alluvial fan deposits (conglomerates, gravels, sands). Early-Middle Pleistocene [2]	no	ridge	RC	D2-D3	D3-D4	0.62	0.07	0.46
	Cascello	Quaternary continental deposits. Fluvial and alluvial fan deposits (conglomerates, gravels, sands). Early-Middle Pleistocene [2]	no	toe	masonry	D3-D4	-	0.58	0.07	0.39
	Voceto	Quaternary ubiquitary deposits Glacis deposit. Sandy-silty colluvial and torrential deposit with sandy pebbles. Holocene [2]	no	toe	masonry	D3-D4	-	0.50	0.07	0.34
	Mosicchio	Laga Formation. Turbidite deposits.	no	toe	masonry	D1-D2	-	0.56	0.07	0.42

[1] Information taken from Seismic Microzonation of Accumoli municipality (Regione Lazio, 2012)

[2] Information taken from Mancini et al., 2017

		Stratified arenaceous rock interbedded with marls. Upper Miocene[2]								
	Casale	Laga Formation. Turbidite deposits. Stratified arenaceous rock interbedded with marls. Upper Miocene[3]	no	slope	masonry	D4-D5	-	0.63	0.08	0.38
	Saletta	Quaternary continental deposits. Fluvial alluvial deposits. Upper Pleistocene [3]	no	slope	masonry	D4-D5	-	0.62	0.09	0.38
	Sommati	Quaternary continental deposits. Fluvial and alluvial fan deposits (conglomerates, gravels, sands). Early-Middle Pleistocene[2]	no	slope	masonry	D3-D4	-	0.60	0.07	0.38
	Villa San Lorenzo Flaviano	Quaternary continental deposits. Fluvial alluvial deposits. Upper Pleistocene[3]	no	slope	masonry	D4-D5	-	0.64	0.09	0.38
	Collecreta	Laga Formation. Turbidite deposits. Siltstone lithofacies. Upper Miocene [2]	no	toe	masonry	D0-D1	-	0.48	0.06	0.33
Arquata del Tronto (3)	Main village	Laga Formation. Turbidite deposits. Arenaceous-pelitic lithofacies. Upper Miocene[4]	yes	ridge	masonry	D4-D5	D4-D5	0.38	0.10	0.26
	Borgo	Quaternary continental deposits. Eluvial/colluvial deposits. Holocene [4]	no	toe	masonry	D2-D3	D3-D4	0.38	0.10	0.27
	Pescara del Tronto (3a)	Quaternary continental deposits. Debris flow deposits. Holocene[4]	yes	slope	masonry	D4-D5	D4-D5	0.48	0.10	0.34
	Tufo	Quaternary continental deposits. Eluvial/colluvial deposits. Holocene [4]	no	slope	masonry	D2-D3	D4-D5	0.53	0.09	0.42
Montegallo (4)	Astorara	Quaternary continental deposits. Eluvial/colluvial deposits. Holoene[4]	no	slope	masonry	D0-D1	D4-D5	0.28	0.12	0.26
	Balzo	Laga Formation. Turbidite deposits. Pelitic-arenaceous lithofacies. Upper Miocene[3]	no	ridge	masonry	-	D2-D3	0.23	0.12	0.23
	Castro	Quaternary continental deposits. Landslide evolving.Holocene[4]	yes	ridge	masonry	D3-D4	D4-D5	0.24	0.12	0.24
	Colle	Laga Formation. Turbidite deposits. Arenaceous lithofacies. Upper Miocene[4]	no	slope	masonry	D2-D3	D4-D5	0.28	0.13	0.27
	Collefratte	Quaternary continental deposits. Landslide evolving. Holocene[4]	yes	ridge	masonry	D2-D3	D3-D4	0.26	0.12	0.25
	Colleluce	Quaternary continental deposits. Landslide evolving. Holocene[4]	yes	slope	masonry	D1-D2	D4-D5	0.28	0.13	0.27
	Piano	Laga Formation. Turbidite deposits. Arenaceous-pelitic lithofacies. Upper Miocene[4]	no	toe	masonry	D0-D1	D0-D1	0.21	0.12	0.22
	Pistrino di Sopra	Quaternary continental deposits. Eluvial-colluvial deposits. Holocene. [4]	yes	slope	masonry	D2-D3	D3-D4	0.22	0.12	0.22
	Propezzano	Laga Formation. Turbidite deposits. Arenaceous lithofacies. Upper Miocene[4]	no	ridge	masonry	-	-	0.16	0.10	0.18

[3] Information taken from Seismic Microzonation of Amatrice municipality (Regione Lazio, 2016)

[4] Information taken from Regione Marche - Geologic Regional Map (CTR Edition), available on http://www.ambiente.marche.it/Territorio/Cartografiaeinformazioniterritoriali/Archiviocartograficoeinformazioniterritoriali/Cartografie/CARTAGEOLOGICAREGIONALE110000.aspx

Norcia (5)	Main village	Quaternary continental deposits. Alluvial cone on terraced alluvial deposits. Holocene[5]	no	toe	masonry	D0-D1	D2-D3	0.28	0.27	0.38
	Castelluccio	Diaspri Formation. Siliceous, sedimentary rock composed mainly of radiolars. Upper Jurassic[5]	no	ridge	masonry	D3-D4	-	0.46	0.16	0.45
	Piè del Colle	Quaternary continental deposits. Alluvial cone on terraced alluvial deposits (gravel, sands, silt). Pleistocene-Holocene[5]	no	slope	masonry and RC	-	D3-D4	0.27	0.45	0.36
	Castello di Campi	Maiolica Formation. Limestone. Upper Jurassic-Lower Cretaceous[5]	no	slope	masonry	-	D2-D3	0.26	0.49	0.36
	Serravalle	Calcari Diasprigni Formation. Limestones. Middle-Upper Jurassic [5]	no	slope	masonry	-	D0-D1	0.14	0.12	0.26
	Popoli	Quaternary continental deposits. Terraced alluvial deposits. Pleistocene-Holocene[5]	no	toe	masonry	-	D2-D3	0.26	0.16	0.54
	San Pellegrino	Quaternary continental deposits. Terraced alluvial deposits often covered by debris flow deposits. Pleistocene-Holcoene[5]	no	slope	masonry	-	D4-D5	0.37	0.18	0.61
Montereale (6)	Main village	Laga Formation. Turbidite deposits. Arenaceous lithofacies. Upper Miocene[6]	no	ridge	masonry	D0-D1	-	0.10	0.02	0.13
	Aringo	Laga Formation. Turbidite deposits. Arenaceous lithofacies. Upper Miocene[6]	no	toe	masonry	D0-D1	-	0.17	0.03	0.18
	Santa Lucia	Laga Formation. Turbidite deposits. Arenaceous lithofacies.Upper Miocene[6]	no	slope	masonry	D2-D3	-	0.22	0.04	0.21
Capitignano (7)	Main village	Quaternary continental deposits. Fluvial-lacustrine deposits, often interfinged with alluvial cone deposits. Holocene[7]	no	toe	retrofitted masonry and RC	D0-D1	-	0.11	0.02	0.12
Visso (8)	-	Quaternary continental deposits. Alluvial and eluvio-colluvial deposits (gravel, sands silt). Holocene[4]	no	toe	masonry	-	D3-D4	0.21	0.39	0.39
Ussita (9)	-	Quaternary continental deposits. Slope deposits.Holocene[4]	no	toe	masonry	-	D3-D4	0.18	0.43	0.43
Tolentino (10)	-	Quaternary continental deposits. Eluvio-colluvial deposits (gravel, sands silt) and terraced alluvial deposits. Upper Pleistocene-Holocene[4]	no	toe	masonry and RC	-	D2-D3	0.09	0.10	0.11
San Severino (11)	-	Quaternary continental deposits. Eluvio-colluvial deposits (gravel, sands silt) and terraced alluvial deposits. Upper Pleistocene-Holocene[4]	no	toe	masonry and RC	-	D1-D2	0.07	0.11	0.11
Camerino (12)	-	Camerino Formation. Turbidite deposit. Arenacous lithofacies. Upper Miocene[4]	no	toe	masonry and RC	-	D1-D2	0.07	0.14	0.18

[5] -Information taken from Geologic cartography of Umbria Region, scale 1:10.000, available on http://www.regione.umbria.it/paesaggio-urbanistica/cartografia-geologica-per-google-earth

[6] Information taken from Centamore et al., (1992).

[7] Information taken from SeismicMicrozonation of Capitignano. Regione Abruzzo

Pievebovigliana (13)	-	Quaternary continental deposits. Terraced alluvial deposits (gravel, sands, silt). Upper Pleistocene[4]	no	toe	masonry	-	D2-D3	0.08	0.18	0.22
Pieve Torina (14)	Main village	Scaglia Cinerea Formation.Gray marly limestones. Upper Eocene-Lower Neogene [4]	no	toe	masonry	-	D3-D4	0.16	0.42	0.34
	Fiume (14a)	Quaternary continental deposits. Alluvial, eluvial-colluvual deposits and debris flow deposits. Holocene[4]	no	toe	masonry	-	D2-D3	0.09	0.21	0.25
	Casavecchia Alta (14b)	Schlier Formation. Marns and calcareous marls. Middle Miocene[4]	no	ridge	masonry	-	D3-D4	0.15	0.41	0.33
Sellano (15)	Main village	Scaglia Bianca, Variegata and Cinerea Formations. Limestone. Middle Cretaceous-Oligocene[5]	no	ridge	masonry	-	D0-D1	0.12	0.06	0.18
	Terne	Quaternary continental deposits. Alluvial cone on alluvial deposits. Holocene[5]	no	toe	masonry	-	D0-D1	0.11	0.07	0.16
	Villamagina	Scaglia Bianca Formation. Limestone. Middle - Upper Cretaceous[5]	no	slope	masonry	-	D0-D1	0.12	0.06	0.18
Cessapalombo (16)	-	Quaternary continental deposits. Terraced alluvial deposits (gravel, sands and silt). Lower - Middle Pleistocene[4]	no	slope	masonry	-	D1-D2	0.07	0.10	0.11
Preci (17)	Main village	Scaglia Rossa Formation. Limestone. Upper Cretaceous-Middle Eocene[5]	no	slope/toe	masonry	-	D0-D1	0.19	0.28	0.32
	Piedivalle	Scaglia Bianca, Variegata and Cinerea Formations. Limestone. Middle Cretaceous-Oligocene[5]	no	toe	masonry	-	D0-D1	0.21	0.34	0.33
Caldarola (18)	-	Quaternary continental deposits. Terraced alluvial deposits. Upper Pleistocene[4]	no	slope	masonry	-	D0-D1	0.07	0.11	0.12
Colfiorito (19)	-	Quaternary continental deposits. Fluvial lacustrine sediments. Pleistocene-Holocene[5]	no	slope	masonry	-	D0-D1	0.18	0.36	0.26
Fiastra (20)	San Lorenzo in Colpolina	Camerino Formation. Turbidite deposit Pelitic-arenacous, and pelitic lithofacies. Upper Miocene[4]	no	ridge	masonry	-	D3-D4	0.07	0.17	0.20

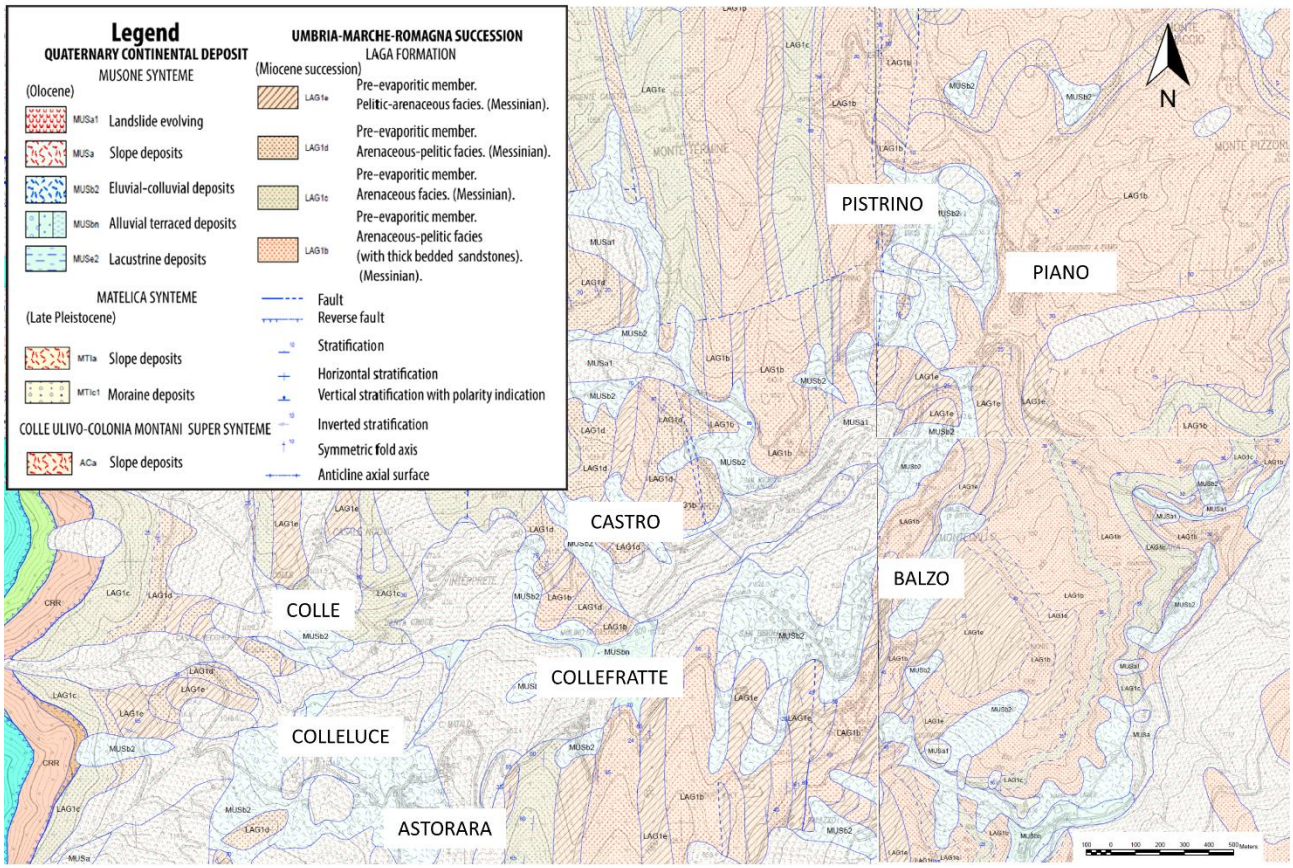

Figure S1. Geological map of the Montegallo area. (source: Regione Marche - Geologic Regional Map available at http://www.ambiente.marche.it/Territorio/Cartografiaeinformazioniterritoriali/Archiviocartograficoeinformazioniterritoriali/Cartografie/CARTAGEOLOGICAREGIONALE110000.aspx, last accessed 25 July 2017).

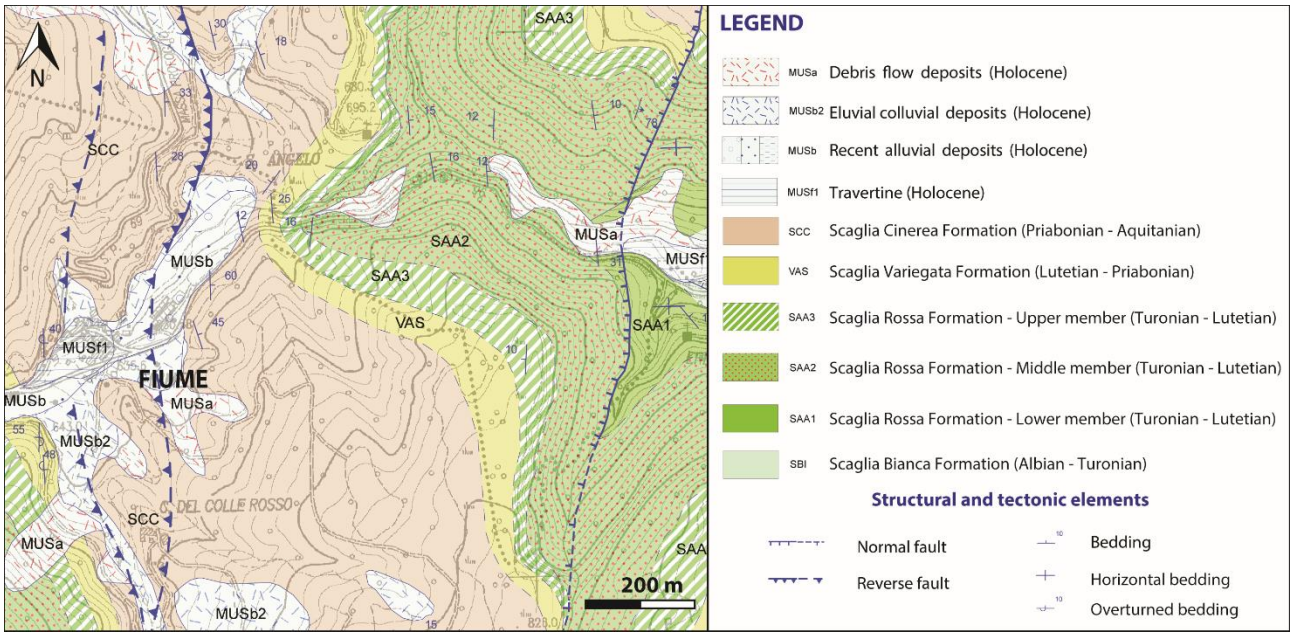

Figure S2. Geology map of the Fiume area on an extract and modified from Progetto CARG, Regione Marche, Section 313130. Legend: MUSa: Debris flow deposits (Holocene); MUSb2: Eluvial-colluvial deposits (Holocene); MUSb: Recent alluvial deposits (Holocene); MUSf1: Travertine (Holocene); SCC: Scaglia Cinerea (Priabonian p.p – Lutetian p.p); VAS: Scaglia Variegata (Lutetian p.p – Priabonian p.p); SAA3: Scaglia Rossa,-upper member (lower Turonian p.p – Lutetian p.p); SAA2: Scaglia Rossa-middle member (lower Turonian p.p-Lutetian p.p).

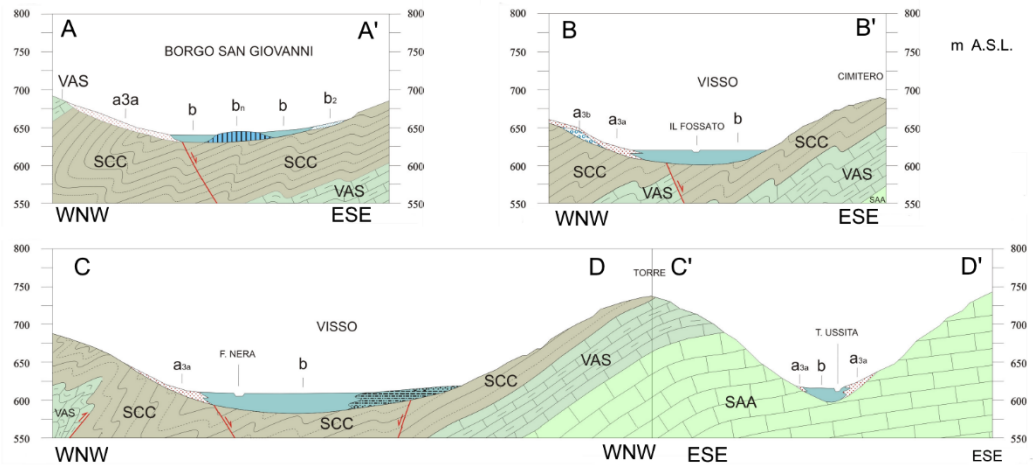

Figure S3. Cross sections (b) of the Visso Village area (Regione Marche, 2012). Successive large outcrops with a stratigraphic sequence characterized by a set of finely stratified sedimentary layers of pelagic environment, with an alternation of calcareous-marly and siliceous calcareous layers. Outcrops consist of the Scaglia sequence: Scaglia Rossa, micritic pinky limestone alternated with marls and brick red marly limestones (SAA3 and SAA2), Scaglia Variegata, pink/green/grey marly limestone, (VAS) and Scaglia Cinerea, grey marly limestone (SCC).

Figure S4. Geological map of the Visso Village area (Regione Marche, 2012). The damage distribution detected during the GEER site-inspection is superimposed on the geological map.

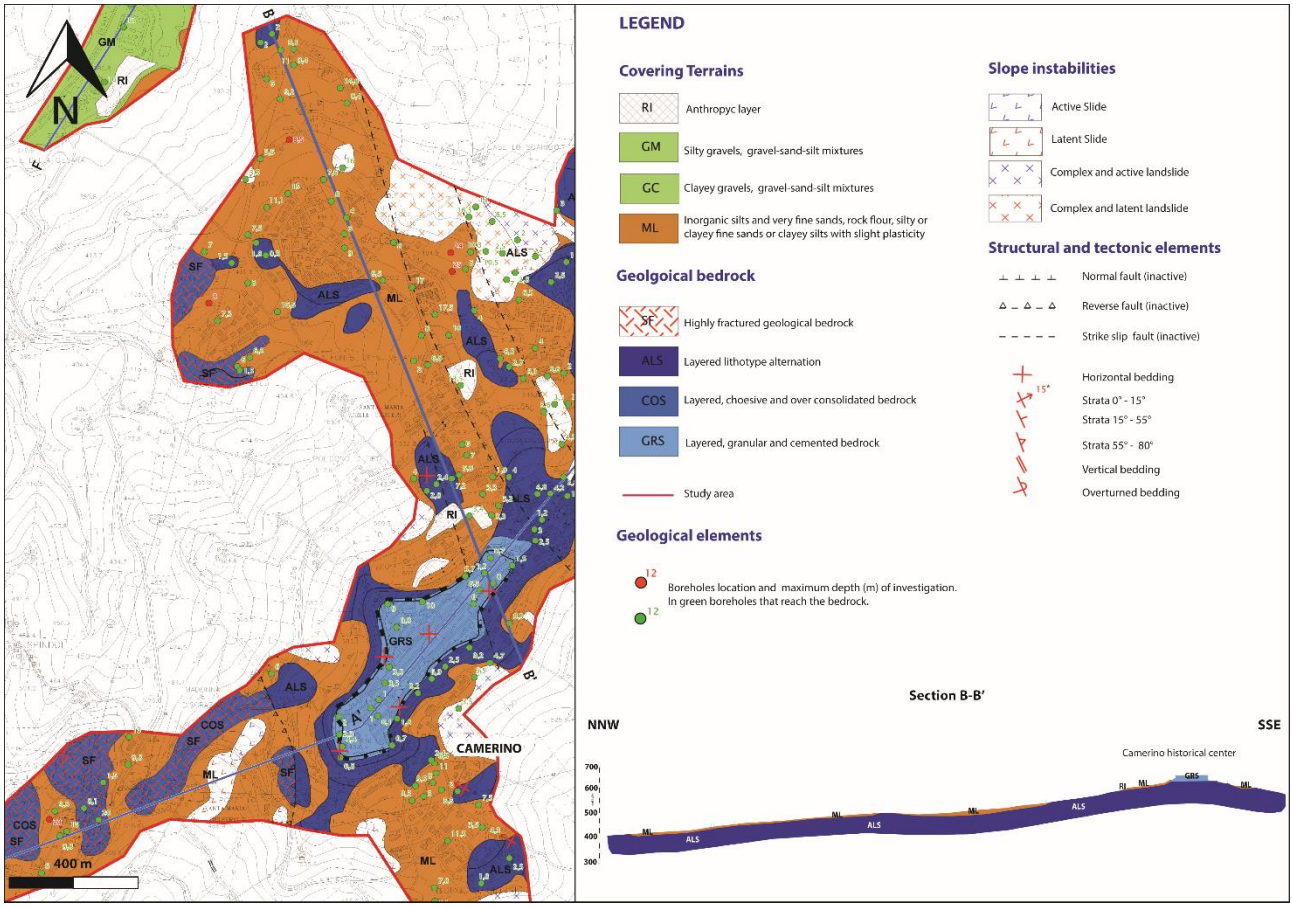

Figure S5. Geological map of Camerino (a) and cross section BB' (b) (Regione Marche, 2012).

Figure S6. Pictures of all structures with assigned damage level D5 in the city center of Norcia, along with their identification numbers.