Table S1. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.15 g intensity level, $V_{S1}(z)$ and $H_{deposit}$ = 50 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	6269	1635	South Iceland	17/06/2000	6.5	strike slip	34
	5085	1464	Mt. Hengill Area	04/06/1998	5.4	strike slip	15
	6335	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	15
	182	87	Tabas	16/09/1978	7.3	oblique	12
	1795	191	Golbasi	06/06/1986	5.8	strike slip	52
	1960	676	Near NE coast of Rodos island	25/10/1987	5.1	-	19
	4678	1635	South Iceland	17/06/2000	6.5	strike slip	32
0.2T_1–2T_1 scaling and Spectral matching	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	368	175	Lazio Abruzzo	07/05/1984	5.9	normal	22
	290	146	Campano Lucano	29548	6.9	normal	32

Table S2. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.35 g intensity level, $V_{S1}(z)$ and $H_{deposit}$ = 50 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	6269	1635	South Iceland	17/06/2000	6.5	strike slip	34
	5085	1464	Mt. Hengill Area	04/06/1998	5.4	strike slip	15
	6335	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	15
	5820	1887	Strofades	18/11/1997	6.6	oblique	136
	287	146	Campano Lucano	23/11/1980	6.9	normal	23
	4674	1635	South Iceland	17/06/2000	6.5	strike slip	5
	6332	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	6
0.2T_1–2T_1 scaling and Spectral matching	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	7142	2309	Bingol	01/05/2003	6.3	strike slip	14
	4674	1635	South Iceland	17/06/2000	6.5	strike slip	5
	1228	472	Izmit	17/08/1999	7.6	strike slip	47
	55	34	Friuli	06/05/1976	6.5	thrust	23

Table S3. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.15 g intensity level, $V_{S1}(z)$ and $H_{deposit}$ = 30 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	6437	2158	Izmit (aftershock)	07/11/1999	4.9	thrust	7
	90	51	Friuli (aftershock)	11/06/1976	4.7	thrust	17
	479	230	Manjil	20/06/1990	7.4	oblique	81
	54	34	Friuli	06/05/1976	6.5	thrust	166
	6169	594	Off coast of Levkas island	01/12/1994	5.3	strike slip	19
	5797	1771	Gulf of Akaba	22/11/1995	7.1	oblique	244
	7116	2302	Pulumur	27/01/2003	6	strike slip	109
0.2T_1–2T_1 scaling and Spectral matching	5820	1887	Strofades	18/11/1997	6.6	oblique	136
	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	342	307	Cazulas	24/06/1984	4.9	oblique	24
	3725	497	Duzce 1	12/11/1999	7.2	oblique	174
	960	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	50
	7160	2313	Firuzabad	20/06/1994	5.9	strike slip	58
	198	93	Montenegro	15/04/1979	6.9	thrust	21

Table S4. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.35 g intensity level, $V_{S1}(z)$ and $H_{deposit}$ = 30 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
$Sa(T_1)$ scaling	6437	2158	Izmit (aftershock)	07/11/1999	4.9	thrust	7
	90	51	Friuli (aftershock)	11/06/1976	4.7	thrust	17
	479	230	Manjil	20/06/1990	7.4	oblique	81
	54	34	Friuli	06/05/1976	6.5	thrust	166
	6169	594	Off coast of Levkas island	01/12/1994	5.3	strike slip	19
	1882	648	Ierissos	26/08/1983	5.1	strike slip	8
	1229	472	Izmit	17/08/1999	7.6	strike slip	73
$0.2T_1$–$2T_1$ scaling and Spectral matching	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	342	307	Cazulas	24/06/1984	4.9	oblique	24
	960	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	50
	234	108	Montenegro (aftershock)	24/05/1979	6.2	thrust	30
	7142	2309	Bingol	01/05/2003	6.3	strike slip	14
	6349	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	5
	55	34	Friuli	06/05/1976	6.5	thrust	23

Table S5. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.15 g intensity level, $V_{S1}(z)$ and $H_{deposit}$ = 15 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	200	93	Montenegro	15/04/1979	6.9	thrust	65
	385	176	Lazio Abruzzo (aftershock)	11/05/1984	5.5	normal	15
	7160	2313	Firuzabad	20/06/1994	5.9	strike slip	58
	401	181	Lazio Abruzzo (aftershock)	11/05/1984	4.8	normal	16
	5828	1896	Strofades (aftershock)	18/11/1997	5.3	strike slip	43
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	372	175	Lazio Abruzzo	07/05/1984	5.9	normal	68
0.2T_1–2T_1 scaling and Spectral matching	5271	1338	Mt. Vatnafjoll	25/05/1987	6	oblique	42
	3725	497	Duzce 1	12/11/1999	7.2	oblique	174
	642	292	Umbria Marche (aftershock)	14/10/1997	5.6	normal	23
	960	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	50
	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	195	93	Montenegro	15/04/1979	6.9	thrust	55
	7142	2309	Bingol	01/05/2003	6.3	strike slip	14

Table S6. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.35 g intensity level, $V_{S1}(z)$ and $H_{deposit}$ = 15 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	490	235	Javakheti Highland	16/12/1990	5.4	strike slip	29
	7281	2336	Azores (aftershock)	28/06/1997	5.1	normal	131
	200	93	Montenegro	15/04/1979	6.9	thrust	65
	6444	2159	Izmit (aftershock)	11/11/1999	5.6	oblique	31
	385	176	Lazio Abruzzo (aftershock)	11/05/1984	5.5	normal	15
	6263	1635	South Iceland	17/06/2000	6.5	strike slip	7
	147	65	Friuli (aftershock)	15/09/1976	6	thrust	14
0.2T_1–2T_1 scaling and Spectral matching	5271	1338	Mt. Vatnafjoll	25/05/1987	6	oblique	42
	3725	497	Duzce 1	12/11/1999	7.2	oblique	174
	642	292	Umbria Marche (aftershock)	14/10/1997	5.6	normal	23
	960	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	50
	6500	497	Duzce 1	12/11/1999	7.2	oblique	23
	372	175	Lazio Abruzzo	07/05/1984	5.9	normal	68
	182	87	Tabas	16/09/1978	7.3	oblique	12

Table S7. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.15 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 50 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	6174	2029	Kozani	13/05/1995	6.5	normal	60
	1228	472	Izmit	17/08/1999	7.6	strike slip	47
	6761	2222	Vrancea	30/08/1986	7.2	thrust	49
	1878	192	Kalamata	13/09/1986	5.9	normal	51
	949	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	29
	1243	473	Izmit (aftershock)	13/09/1999	5.8	oblique	15
	198	93	Montenegro	15/04/1979	6.9	thrust	21
0.2T_1–2T_1 scaling and Spectral matching	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	616	286	Umbria Marche	26/09/1997	6	normal	59
	368	175	Lazio Abruzzo	07/05/1984	5.9	normal	22
	7142	2309	Bingol	01/05/2003	6.3	strike slip	14
	55	34	Friuli	06/05/1976	6.5	thrust	23
	290	146	Campano Lucano	23/11/1980	6.9	normal	32

Table S8. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.35 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 50 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	6174	2029	Kozani	13/05/1995	6.5	normal	60
	1228	472	Izmit	17/08/1999	7.6	strike slip	47
	6761	2222	Vrancea	30/08/1986	7.2	thrust	49
	5807	1885	Kalamata	13/10/1997	6.4	thrust	93
	6332	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	6
	290	146	Campano Lucano	23/11/1980	6.9	normal	32
	6349	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	5
0.2T_1–2T_1 scaling and Spectral matching	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	368	175	Lazio Abruzzo	07/05/1984	5.9	normal	22
	6761	2222	Vrancea	30/08/1986	7.2	thrust	49
	182	87	Tabas	16/09/1978	7.3	oblique	12
	4674	1635	South Iceland	17/06/2000	6.5	strike slip	5
	1231	472	Izmit	17/08/1999	7.6	strike slip	9

Table S9. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.15 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 30 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	629	291	Umbria Marche (aftershock)	06/10/1997	5.5	normal	36
	961	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	51
	949	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	29
	4674	1635	South Iceland	17/06/2000	6.5	strike slip	5
	473	228	Vrancea	31/05/1990	6.3	thrust	7
	949	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	29
	1231	472	Izmit	17/08/1999	7.6	strike slip	9
0.2T_1–2T_1 scaling and Spectral matching	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	368	175	Lazio Abruzzo	07/05/1984	5.9	normal	22
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	198	93	Montenegro	15/04/1979	6.9	thrust	21

Table S10. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.35 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 30 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
Sa(T_1) scaling	629	291	Umbria Marche (aftershock)	06/10/1997	5.5	normal	36
	961	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	51
	949	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	29
	4674	1635	South Iceland	17/06/2000	6.5	strike slip	5
	6332	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	6
	7142	2309	Bingol	01/05/2003	6.3	strike slip	14
	6349	2142	South Iceland (aftershock)	21/06/2000	6.4	strike slip	5
0.2T_1–2T_1 scaling and Spectral matching	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	292	146	Campano Lucano	23/11/1980	6.9	normal	25
	5819	1885	Kalamata	13/10/1997	6.4	thrust	48
	4674	1635	South Iceland	17/06/2000	6.5	strike slip	5
	290	146	Campano Lucano	23/11/1980	6.9	normal	32
	55	34	Friuli	06/05/1976	6.5	thrust	23

Table S11. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.15 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 15 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
$Sa(T_1)$ scaling	90	51	Friuli (aftershock)	11/06/1976	4.7	thrust	17
	479	230	Manjil	20/06/1990	7.4	oblique	81
	6437	2158	Izmit (aftershock)	07/11/1999	4.9	thrust	7
	7116	2302	Pulumur	27/01/2003	6	strike slip	109
	348	168	Kefallinia (aftershock)	23/03/1983	5.2	normal	11
	141	65	Friuli (aftershock)	15/09/1976	6	thrust	46
	302	146	Campano Lucano	23/11/1980	6.9	normal	92
$0.2T_1$–$2T_1$ scaling and Spectral matching	5820	1887	Strofades	18/11/1997	6.6	oblique	136
	342	307	Cazulas	24/06/1984	4.9	oblique	24
	5825	1885	Kalamata	13/10/1997	6.4	thrust	103
	3725	497	Duzce 1	12/11/1999	7.2	oblique	174
	960	424	Sicilia-Orientale	13/12/1990	5.6	strike slip	50
	5814	1885	Kalamata	13/10/1997	6.4	thrust	61
	1902	659	Anchialos	30/04/1985	5.6	normal	55

Table S12. Main characteristics of the selected earthquake signals based on Sa(T1) scaling, 0.2T1-2T1 scaling, and full spectral matching for 0.35 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 15 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
$Sa(T_1)$ scaling	90	51	Friuli (aftershock)	11/06/1976	4.7	thrust	17
	479	230	Manjil	20/06/1990	7.4	oblique	81
	6437	2158	Izmit (aftershock)	07/11/1999	4.9	thrust	7
	348	168	Kefallinia (aftershock)	23/03/1983	5.2	normal	11
	141	65	Friuli (aftershock)	15/09/1976	6	thrust	46
	1882	648	Ierissos	26/08/1983	5.1	strike slip	8
	1251	472	Izmit	17/08/1999	7.6	strike slip	92
$0.2T_1$–$2T_1$ scaling and Spectral matching	439	213	Spitak	07/12/1988	6.7	thrust	36
	6968	473	Izmit (aftershock)	13/09/1999	5.8	oblique	179
	6263	1635	South Iceland	17/06/2000	6.5	strike slip	7
	5820	1887	Strofades	18/11/1997	6.6	oblique	136
	7142	2309	Bingol	01/05/2003	6.3	strike slip	14
	414	192	Kalamata	13/09/1986	5.9	normal	11
	146	65	Friuli (aftershock)	15/09/1976	6	thrust	14

Table S13. Main characteristics of the selected earthquake signals based on PGA scaling for 0.15 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 15 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
PGA scaling	55	34	Friuli	06/05/1976	6.5	thrust	23
	59	35	Friuli (aftershock)	07/05/1976	5.2	thrust	27
	95	52	Friuli (aftershock)	17/06/1976	5.2	oblique	26
	128	63	Friuli (aftershock)	15/09/1976	6	thrust	28
	149	65	Friuli (aftershock)	15/09/1976	6	thrust	12
	169	80	Calabria	11/03/1978	5.2	normal	10
	182	87	Tabas	16/09/1978	7.3	oblique	12

Table S14. Main characteristics of the selected earthquake signals based on PGA scaling for 0.35 g intensity level, $V_{S2}(z)$ and $H_{deposit}$ = 15 m.

	Waveform ID	Earthquake ID	Earthquake name	Date	Magnitude	Fault mechanism	Epicentral distance (km)
PGA scaling	55	34	Friuli	06/05/1976	6.5	thrust	23
	59	35	Friuli (aftershock)	07/05/1976	5.2	thrust	27
	128	63	Friuli (aftershock)	15/09/1976	6	thrust	28
	149	65	Friuli (aftershock)	15/09/1976	6	thrust	12
	169	80	Calabria	11/03/1978	5.2	normal	10
	182	87	Tabas	16/09/1978	7.3	oblique	12
	193	91	Montenegro	09/04/1979	5.4	thrust	15