

Fractal Derivatives and Singularity Analysis of Frequency–Depth Clusters of Earthquakes along Converging Plate Boundaries

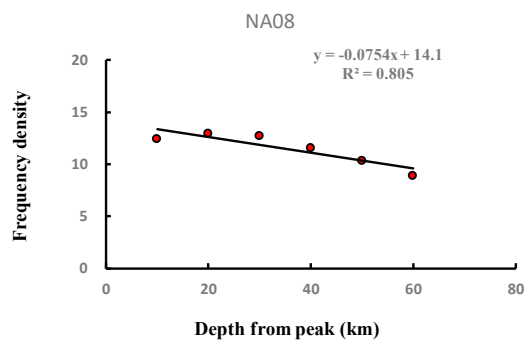
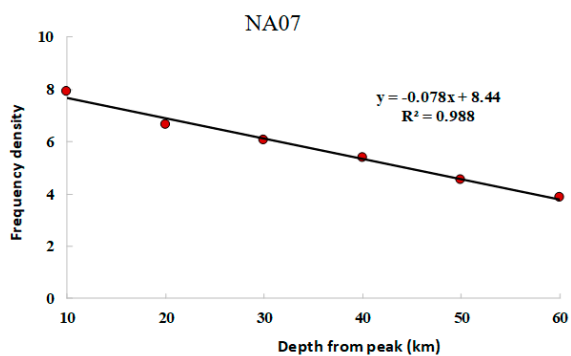
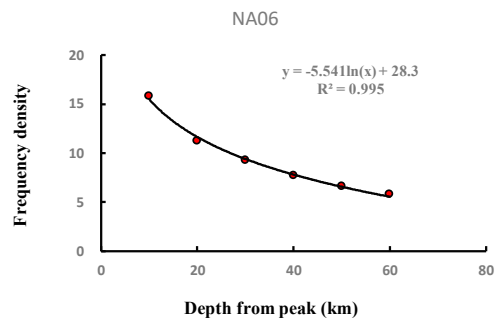
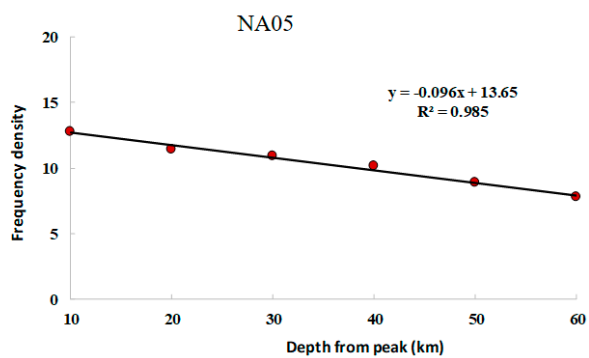
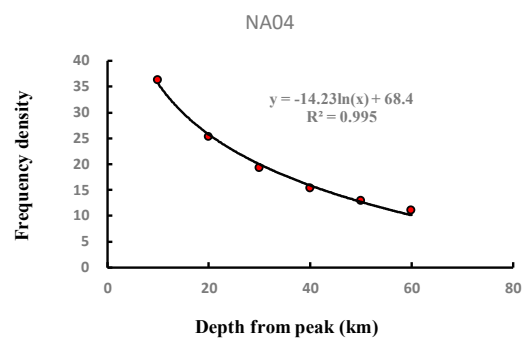
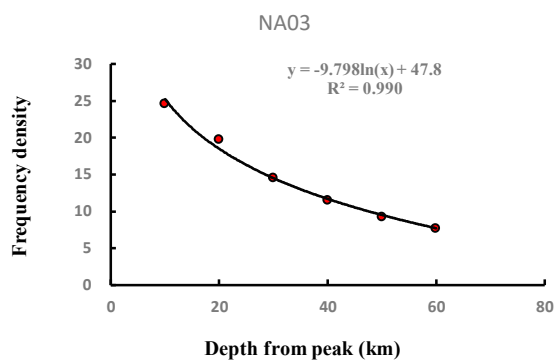
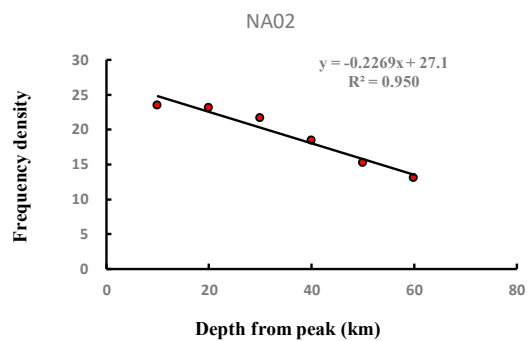
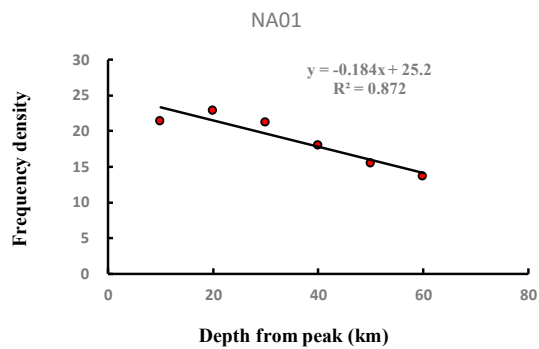
Table S1. Statistics of earthquakes around the Moho in 130 datasets from the study areas.

Location of profiles in tectonic zones	Profiles	Area (km ²)	Number of Earthquakes	Average Magnitudes	Average depth (km)	Type of models	c-value	R ²	t-value
Tethys Belt	TB-01	173399	802	3.76	47	2	-15.42	0.999	63.21
Tethys Belt	TB-02	169884	756	3.73	48	2	-14.68	0.997	36.46
Tethys Belt	TB-03	175460	756	3.76	50	2	-12.73	0.997	36.46
Tethys Belt	TB-04	182601	767	3.74	47	2	-16.85	0.989	18.96
Tethys Belt	TB-05	165399	740	3.75	50	2	-11.52	0.999	63.21
Tethys Belt	TB-06	153681	243	4.00	57	2	-1.74	0.993	23.82
Tethys Belt	TB-07	151851	146	4.14	59	-	-	-	-
Tethys Belt	TB-08	148710	57	3.82	49	-	-	-	-
Tethys Belt	TB-09	135471	14	4.26	47	2	-0.33	0.998	44.68
Tethys Belt	TB-10	136550	7	4.39	41	2	-0.18	0.990	19.90
Tethys Belt	TB-11	144507	2	3.90	38	-	-	-	-
Tethys Belt	TB-12	122183	5	4.26	39	3	-0.90	0.992	22.27
Tethys Belt	TB-13	110155	15	4.33	47	2	-0.33	0.984	15.68
Tethys Belt	TB-14	148229	23	4.38	49	2	-0.35	0.989	18.96
Tethys Belt	TB-15	148382	55	4.63	46	2	-1.07	0.999	63.21
Tethys Belt	TB-16	194820	58	4.40	49	2	-0.99	0.999	63.21
Tethys Belt	TB-17	198833	43	4.59	54	1	-0.01	0.949	8.63
Tethys Belt	TB-18	202264	80	4.73	51	1	-0.04	0.969	11.18
Tethys Belt	TB-19	210052	122	4.64	50	1	-0.05	0.976	12.75
Tethys Belt	TB-20	181488	105	4.53	49	1	-0.05	0.978	13.33
Tethys Belt	TB-21	194345	92	4.58	46	2	-1.97	0.992	22.27
Tethys Belt	TB-22	181286	88	4.35	50	2	-1.38	0.998	44.68
Tethys Belt	TB-23	145177	180	4.58	51	1	-0.07	0.989	18.96
Tethys Belt	TB-24	160791	17	5.17	64	-	-	-	-
Tethys Belt	TB-25	161000	28	4.65	52	1	-0.01	0.921	6.83
Tethys Belt	TB-26	106323	35	4.59	42	3	-0.84	0.994	25.74
Tethys Belt	TB-27	156012	149	4.35	51	2	-2.34	0.997	36.46
Tethys Belt	TB-28	232839	409	4.37	60	3	-0.30	0.981	14.37
Tethys Belt	TB-29	203655	807	4.32	67	-	-	-	-
Tethys Belt	TB-30	236939	663	4.35	52	2	-8.46	0.995	28.21
Tethys Belt	TB-31	210228	145	4.17	54	2	-1.63	0.996	31.56
Tethys Belt	TB-32	240497	94	4.37	47	2	-1.61	0.986	16.78
Tethys Belt	TB-33	245988	68	4.43	47	2	-1.55	0.995	28.21
Tethys Belt	TB-34	255335	57	4.36	50	3	-0.58	0.987	17.43
Tethys Belt	TB-35	257653	90	4.39	50	1	-0.04	0.991	20.99
Tethys Belt	TB-36	264873	147	4.33	50	1	-0.06	0.974	12.24
Tethys Belt	TB-37	168820	346	4.52	66	-	-	-	-
Tethys Belt	TB-38	160958	119	4.58	64	-	-	-	-

Tethys Belt	TB-39	168674	63	4.60	61	-	-	-	-
Tethys Belt	TB-40	169134	28	4.48	51	2	-0.27	0.925	7.02
Tethys Belt	TB-41	152075	201	4.54	43	3	-0.87	0.998	44.68
Tethys Belt	TB-42	155171	132	4.55	49	3	-0.66	0.994	25.74
Tethys Belt	TB-43	151776	161	4.69	53	2	-2.20	0.995	28.21
Tethys Belt	TB-44	141529	250	4.58	46	3	-0.77	0.991	20.99
Tethys Belt	TB-45	142653	463	4.74	53	1	-0.15	0.974	12.24
Tethys Belt	TB-46	142018	469	4.54	47	3	-0.74	0.994	25.74
Tethys Belt	TB-47	141601	371	4.57	48	3	-0.70	0.997	36.46
Tethys Belt	TB-48	149688	261	4.61	49	3	-0.69	0.999	63.21
Tethys Belt	TB-49	147876	494	4.66	45	2	-13.45	0.972	11.78
Tethys Belt	TB-50	150062	604	4.79	55	2	-5.43	0.983	15.21
Tethys Belt	TB-51	124557	399	4.74	53	2	-4.51	0.996	31.56
Tethys Belt	TB-52	119114	260	4.66	57	3	-0.39	0.991	20.99
Tethys Belt	TB-53	132525	230	4.59	61	3	-0.39	0.840	4.58
Tethys Belt	TB-54	135000	234	4.64	59	3	-0.32	0.935	7.59
Tethys Belt	TB-55	136472	221	4.60	55	2	-2.45	0.997	36.46
Tethys Belt	TB-56	136720	200	4.49	52	2	-3.12	0.992	22.27
Tethys Belt	TB-57	135686	295	4.44	53	1	-0.12	0.986	16.78
West Pacific	WP-20	173193	1143	4.71	59	2	-9.51	0.997	36.46
West Pacific	WP-19	168671	1704	4.66	55	1	-0.07	0.947	8.45
West Pacific	WP-18	164729	1111	4.69	61	1	-0.11	0.738	3.36
West Pacific	WP-17	167143	884	4.78	58	1	-0.16	0.985	16.21
West Pacific	WP-16	177806	539	4.67	53	1	-0.36	0.953	9.01
West Pacific	WP-15	181260	173	4.64	47	1	-0.19	0.983	15.21
West Pacific	WP-14	134368	272	4.63	53	2	-12.68	0.985	16.21
West Pacific	WP-33	182414	206	4.49	53	2	-47.60	0.999	63.21
West Pacific	WP-32	171557	227	4.48	51	3	-0.61	0.996	31.56
West Pacific	WP-31	165553	419	4.56	49	2	-3.67	0.993	23.82
West Pacific	WP-30	183418	321	4.60	48	2	-2.06	0.994	25.74
West Pacific	WP-29	185608	33	4.46	45	3	-0.65	0.994	25.74
West Pacific	WP-28	201492	78	4.33	46	1	-0.10	0.988	18.15
West Pacific	WP-08	192028	3043	4.52	50	1	-0.10	0.996	31.56
West Pacific	WP-07	234999	1335	4.61	54	2	-3.85	0.996	31.56
West Pacific	WP-06	267035	565	4.61	55	2	-6.99	0.999	63.21
West Pacific	WP-05	288408	978	4.80	52	2	-4.63	0.983	15.21
West Pacific	WP-04	313646	676	4.60	56	3	-0.24	0.862	5.00
West Pacific	WP-03	340505	596	4.77	55	3	-0.44	0.993	23.82
West Pacific	WP-02	381376	408	4.74	58	3	-0.27	0.949	8.63
West Pacific	WP-01	415782	656	4.67	51	2	-2.63	0.998	44.68
West Pacific	WP-09	157683	292	4.54	51	3	-0.61	0.996	31.56
West Pacific	WP-10	105845	153	4.51	48	3	-0.70	0.990	19.90
West Pacific	WP-11	136550	126	4.63	52	*	-	-	-
West Pacific	WP-12	118567	219	4.68	50	*	-	-	-
West Pacific	WP-13	109526	478	4.66	56	*	-	-	-
West Pacific	WP-21	105172	163	4.50	49	1	-0.17	0.993	23.82
West Pacific	WP-22	101711	584	4.55	49	2	-1.85	0.992	22.27
West Pacific	WP-23	100640	235	4.54	50	2	-0.73	0.993	23.82
West Pacific	WP-24	100428	203	4.54	65	2	-5.38	0.993	23.82
West Pacific	WP-25	94904	514	4.38	61	1	-0.23	0.985	16.21
West Pacific	WP-26	92763	460	4.47	60	3	-0.60	0.993	23.82
West Pacific	WP-27	102238	469	4.55	51	2	-2.51	0.998	44.68
North Pacific	NA-01	736435	821	4.26	54	1	-0.18	0.872	5.22

North Pacific	NA-02	703913	788	4.18	52	1	-0.23	0.950	8.72
North Pacific	NA-03	687751	533	4.01	49	2	-9.80	0.990	19.90
North Pacific	NA-04	665019	665	3.99	47	2	-14.20	0.995	28.21
North Pacific	NA-05	699390	465	3.75	55	1	-0.10	0.985	16.20
North Pacific	NA-06	728489	353	3.80	51	2	-5.54	0.995	28.21
North Pacific	NA-07	755189	233	3.76	55	1	-0.08	0.988	18.15
North Pacific	NA-08	745533	559	3.76	58	1	-0.08	0.805	4.06
North Pacific	NA-09	737667	2229	3.55	62	*	-	-	-
North Pacific	NA-10	721155	1232	3.55	52	2	-17.30	0.997	36.46
North Pacific	NA-11	694979	24	3.83	44	*	-	-	-
North Pacific	NA-12	706849	11	3.85	56	*	-	-	-
North Pacific	NA-13	649333	8	3.49	47	*	-	-	-
North Pacific	NA-14	526726	0	0.00	0	*	-	-	-
North Pacific	NA-15	505011	0	0.00	0	*	-	-	-
North Pacific	NA-16	455937	1	4.00	35	*	-	-	-
North Pacific	NA-17	440137	11	3.80	39	*	-	-	-
North Pacific	NA-18	319837	22	3.75	48	*	-	-	-
North Pacific	NA-19	303463	55	3.58	39	*	-	-	-
North Pacific	NA-20	115751	53	4.45	59	*	-	-	-
North Pacific	NA-21	180162	632	4.11	54	1	-0.15	0.914	6.52
North Pacific	NA-22	195351	542	4.17	59	1	-0.07	0.894	5.81
North Pacific	NA-23	200952	1180	4.51	58	2	-7.10	0.960	9.80
North Pacific	NA-24	181002	1077	4.51	59	1	-0.12	0.829	4.40
North Pacific	NA-25	118276	207	4.55	54	2	-2.15	0.989	18.96
South East Pacific	SA-01	224885	158	4.45	59	1	-0.03	0.972	11.78
South East Pacific	SA-02	231853	72	4.57	51	1	-0.03	0.987	17.43
South East Pacific	SA-03	219063	189	4.70	57	3	-0.37	0.997	36.46
South East Pacific	SA-04	226408	186	4.52	51	2	-2.58	0.988	18.15
South East Pacific	SA-05	244839	166	4.76	56	*	-	-	-
South East Pacific	SA-06	238784	370	4.55	51	3	-0.57	0.996	31.56
South East Pacific	SA-07	238571	304	4.59	61	2	-1.16	0.978	13.33
South East Pacific	SA-08	264125	432	4.50	58	3	-0.42	0.992	22.27
South East Pacific	SA-09	299405	432	4.56	62	3	-0.37	0.917	6.65
South East Pacific	SA-10	304873	538	4.25	57	2	-5.08	0.987	17.43
South East Pacific	SA-11	305142	2335	3.88	54	2	-26.9	0.996	31.56
South East Pacific	SA-12	302631	2168	3.85	52	3	-0.61	0.997	36.46
South East Pacific	SA-13	307743	679	4.35	47	3	-0.83	0.999	63.21
South East Pacific	SA-14	317073	253	4.60	40	3	-0.96	1.000	-

Note: * and - stand for no data; model types 1 – linear, 2 log-linear, and 3 log-log linear.



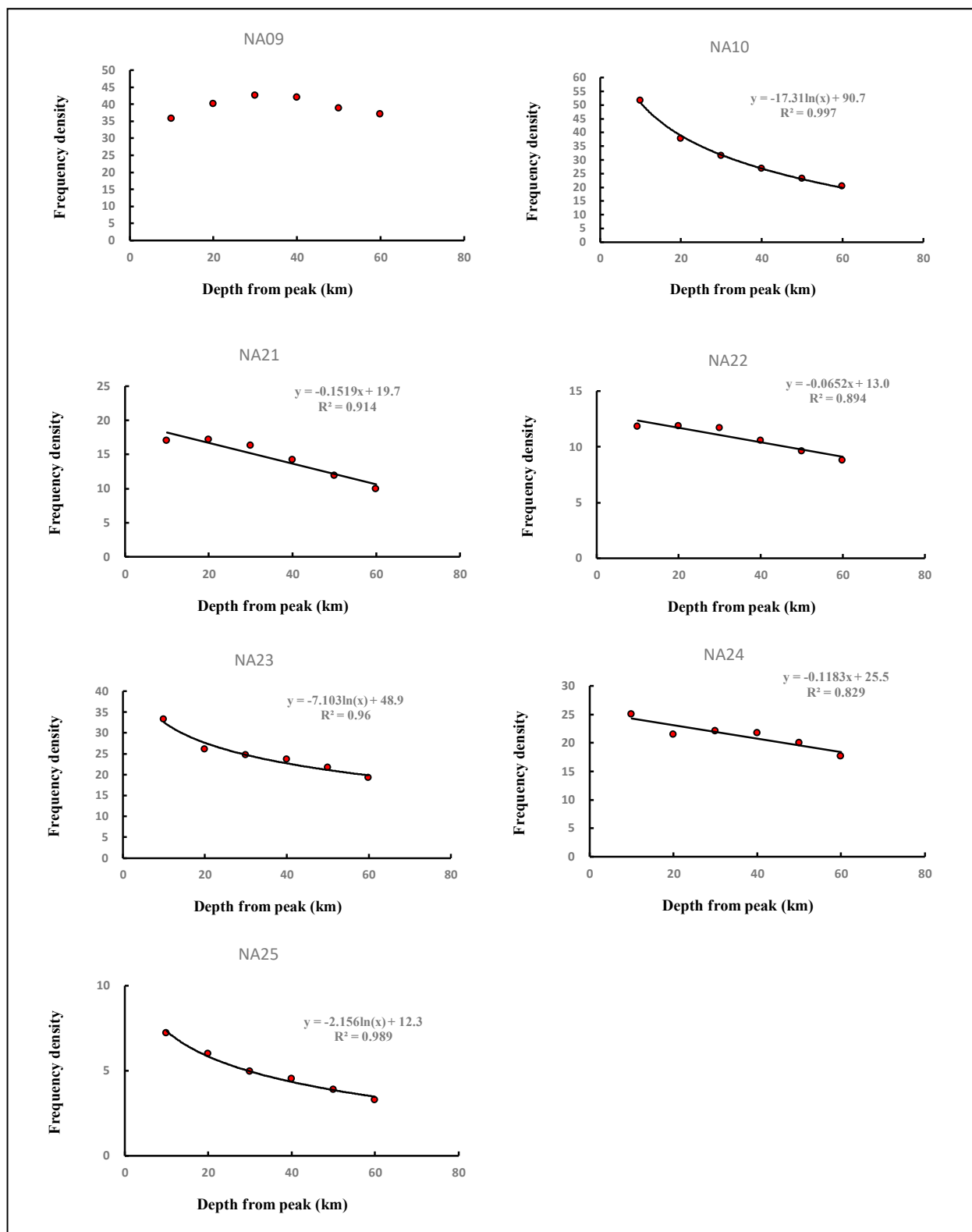
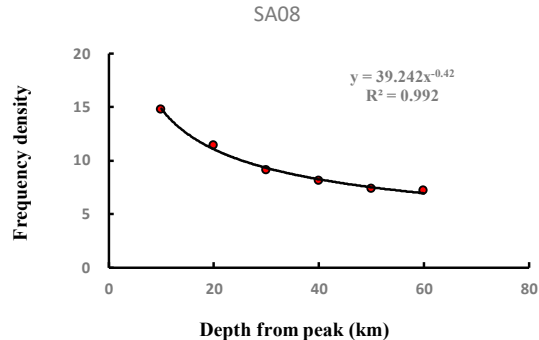
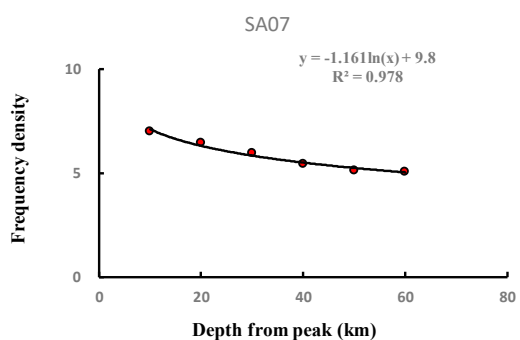
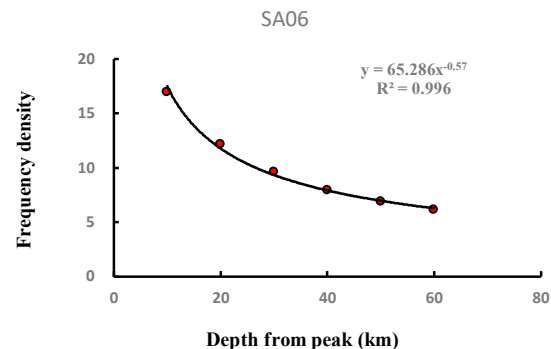
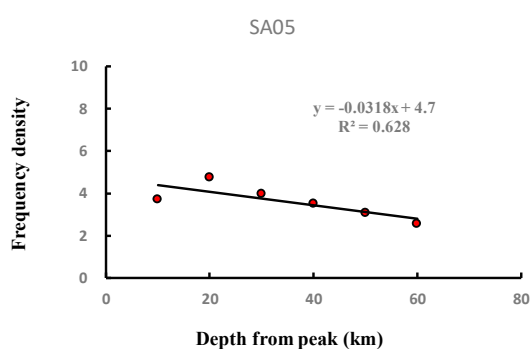
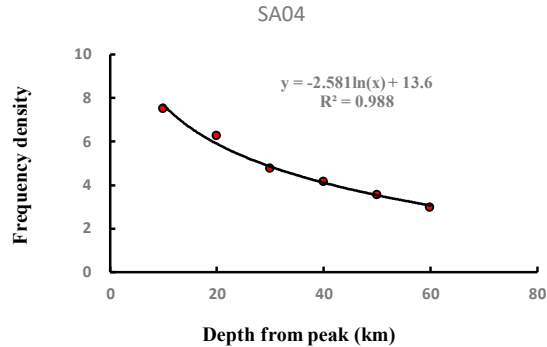
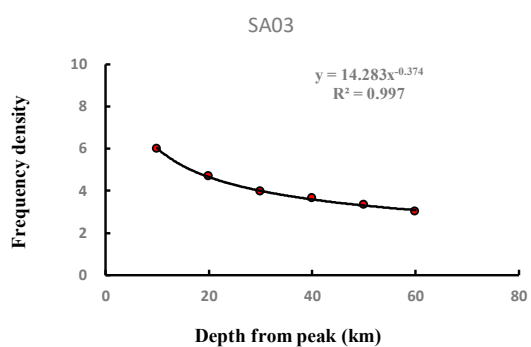
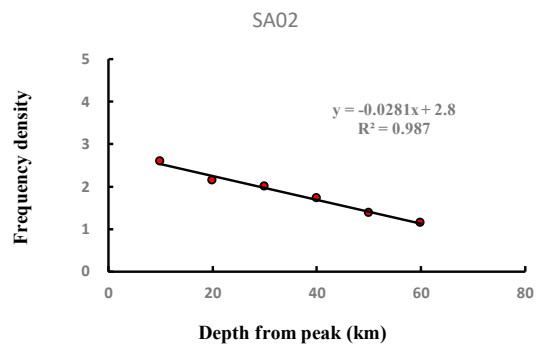
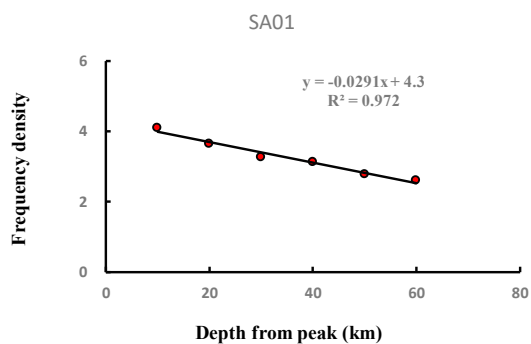


Figure S1. Frequency – depth distribution of earthquakes in the north and northeastern Pacific.



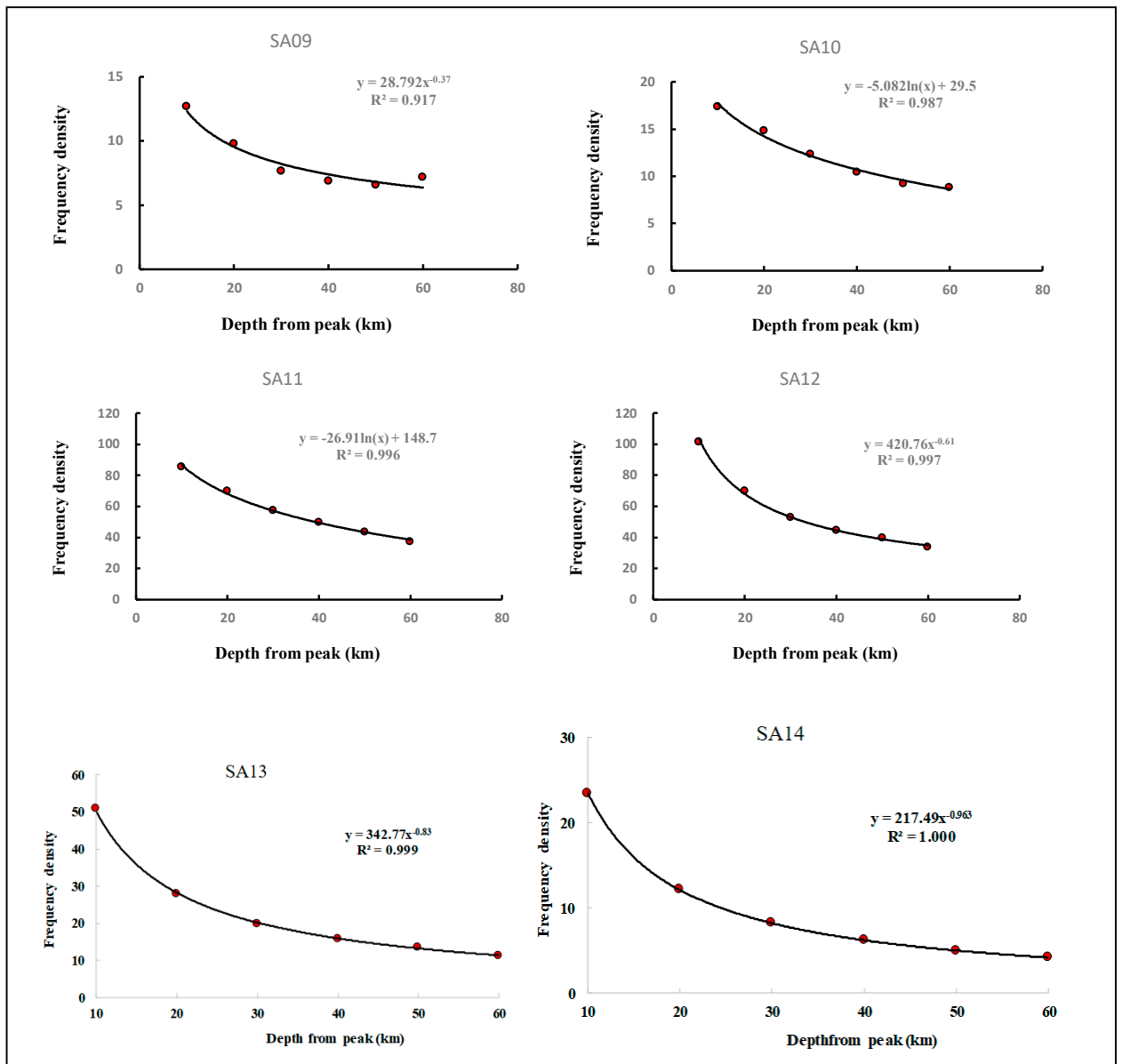
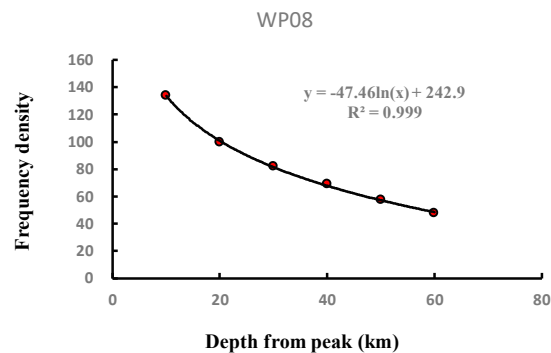
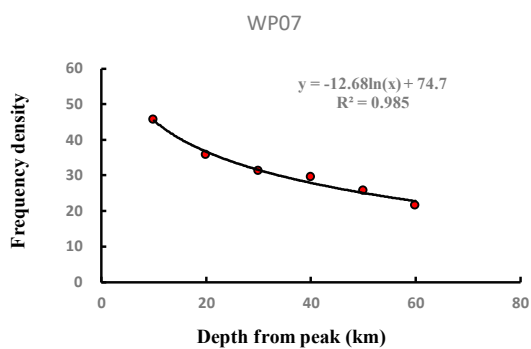
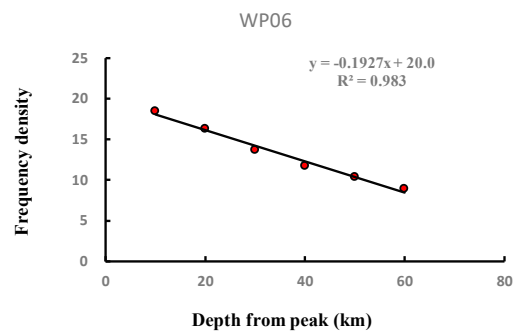
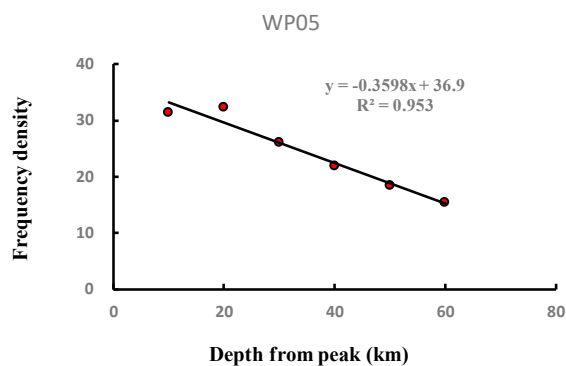
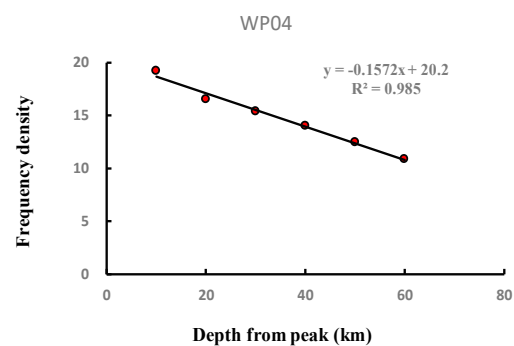
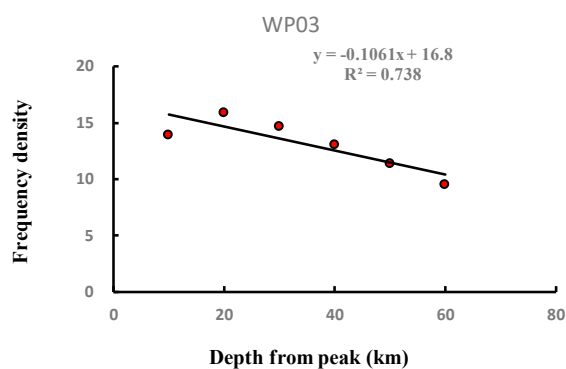
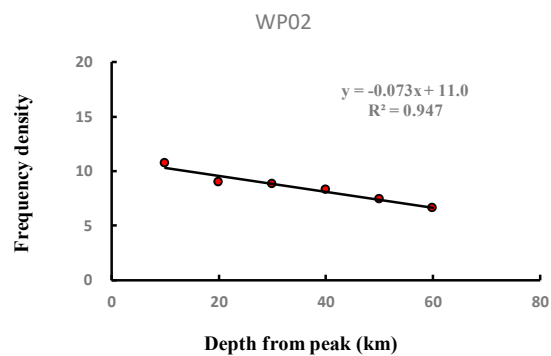
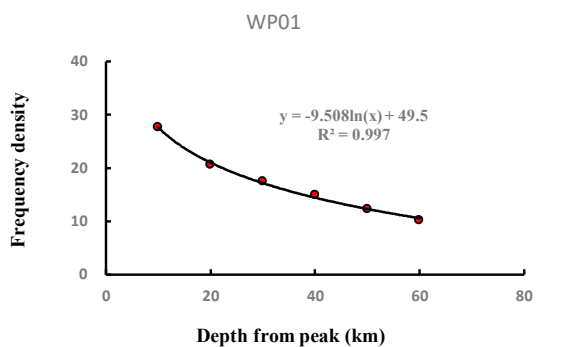
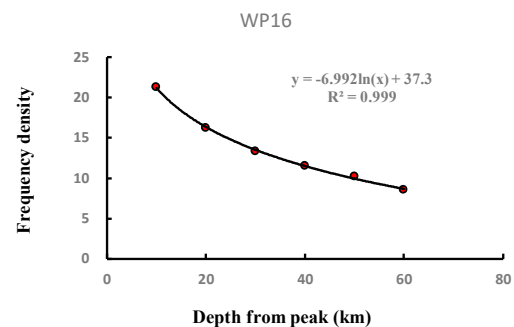
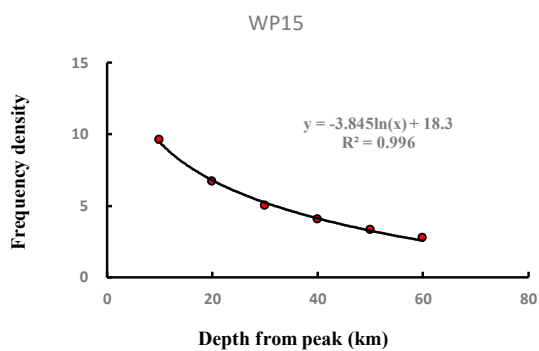
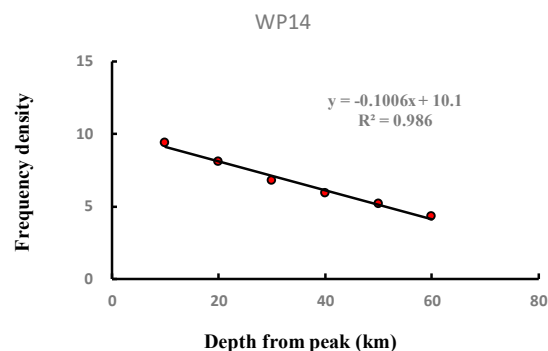
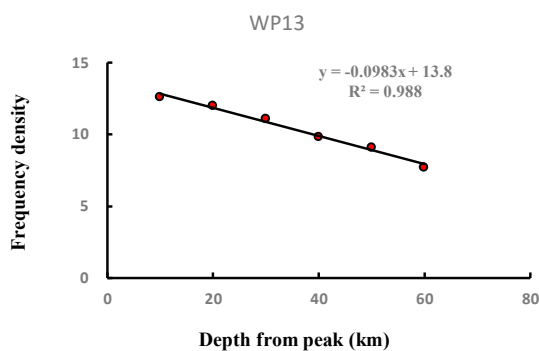
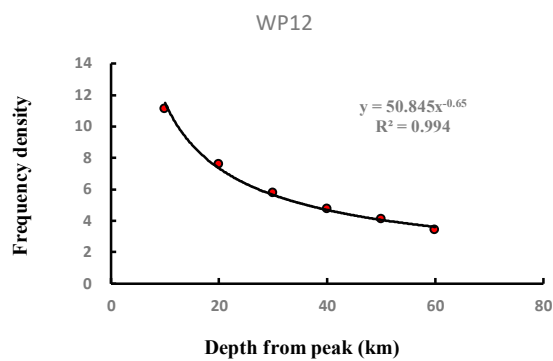
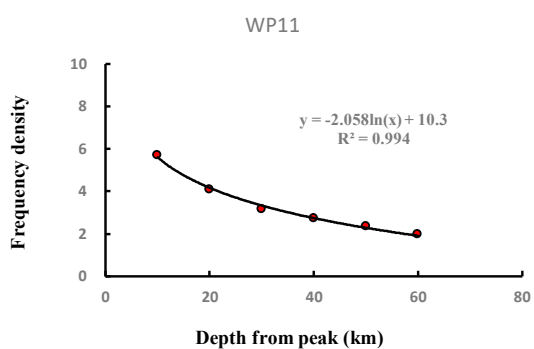
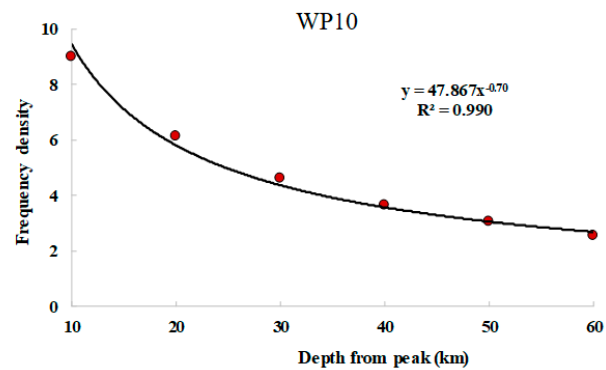
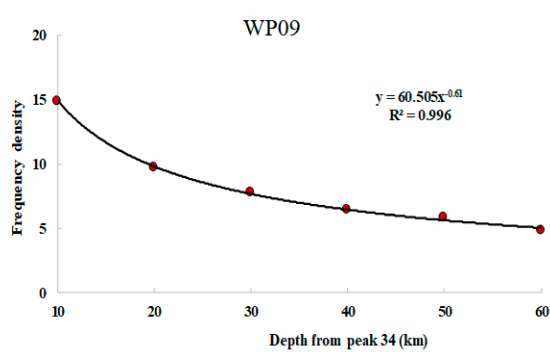
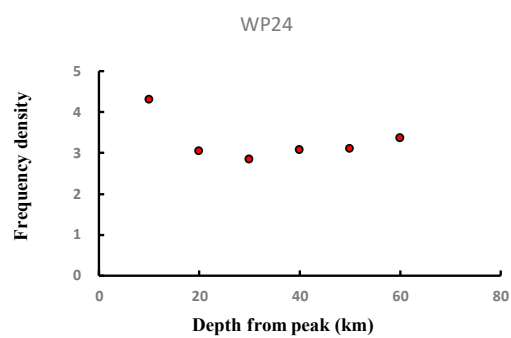
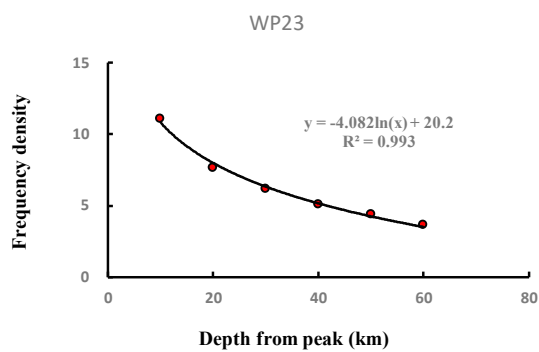
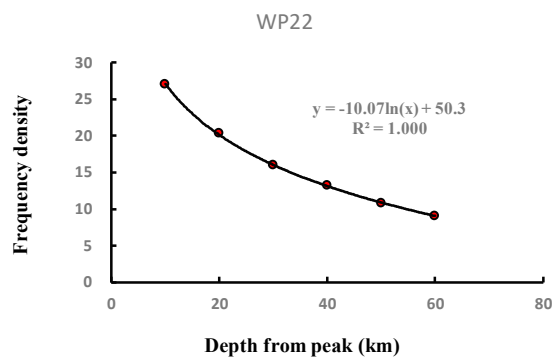
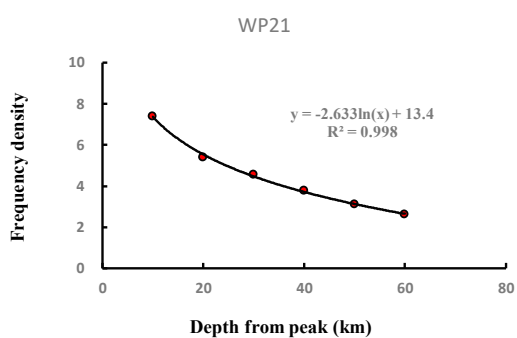
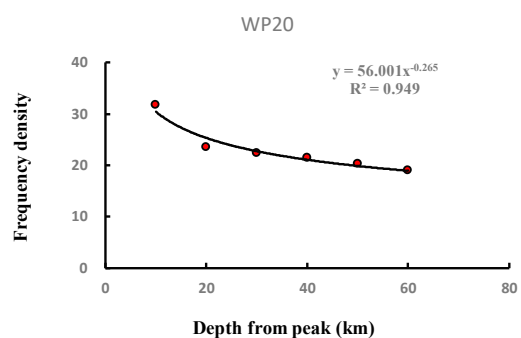
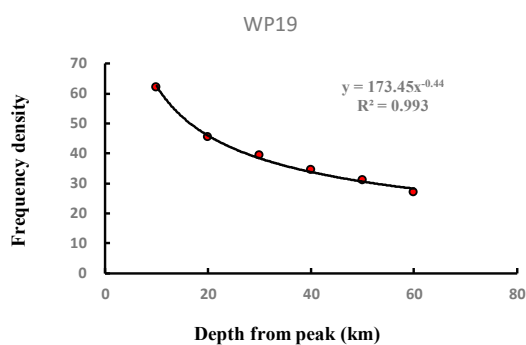
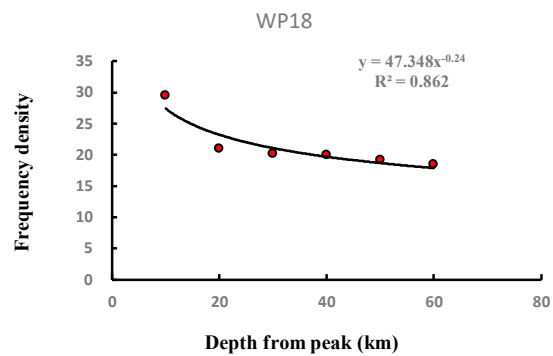
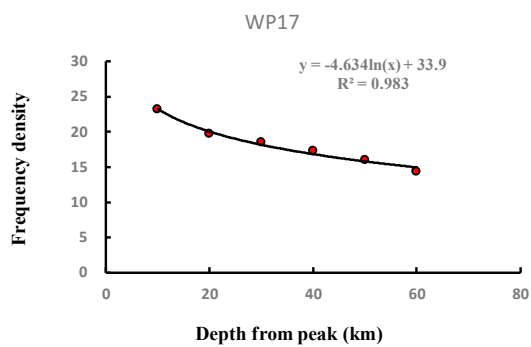
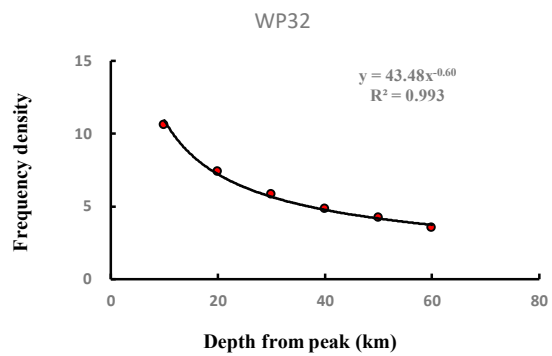
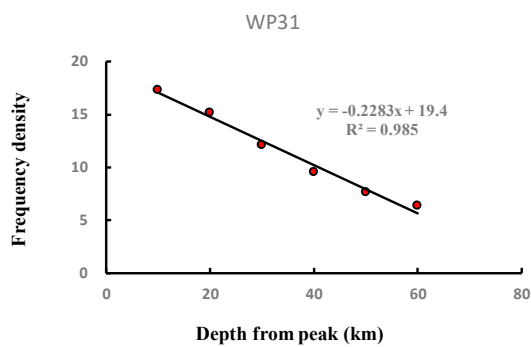
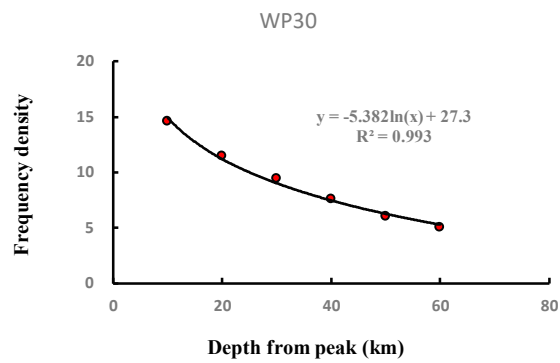
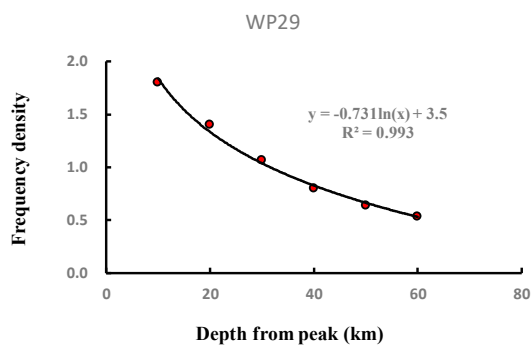
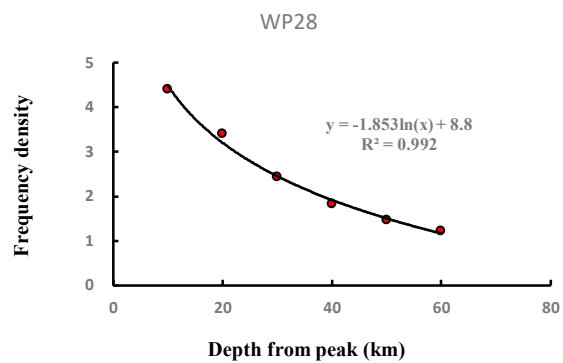
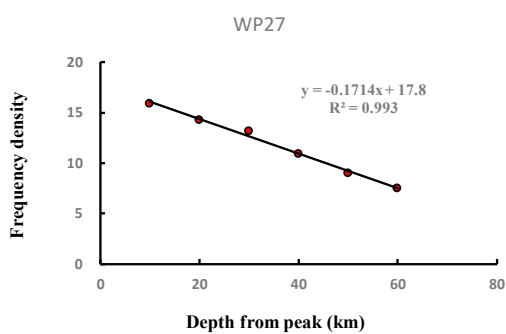
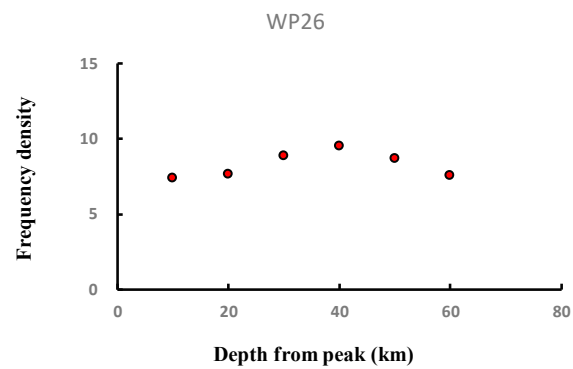
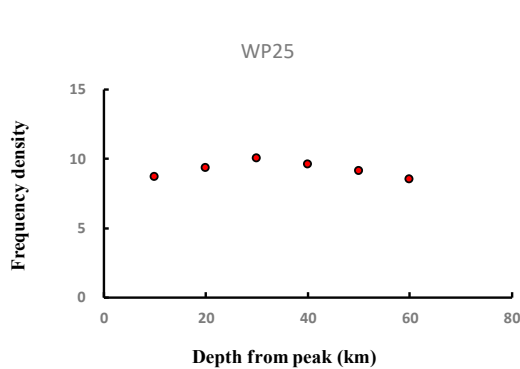


Figure S2. Frequency – depth distribution of earthquakes in north and southeastern Pacific.









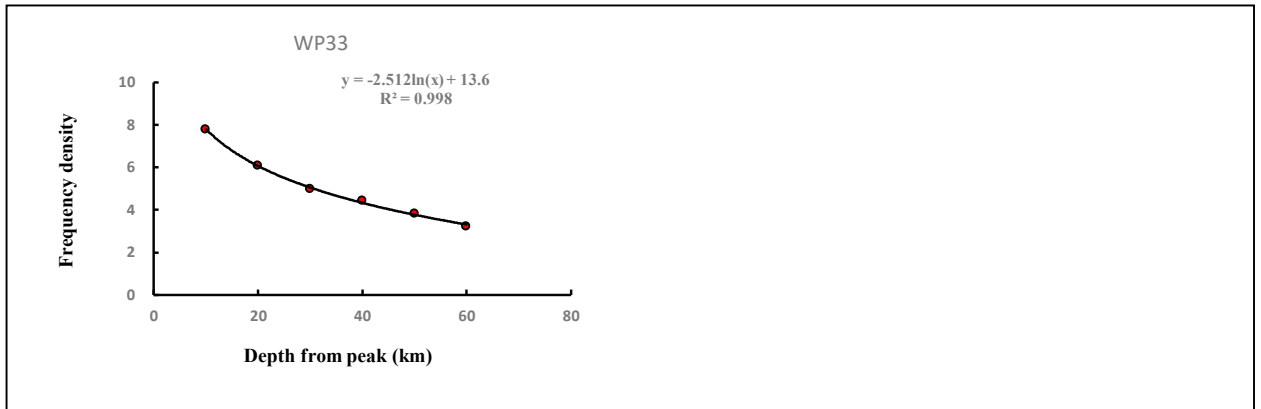
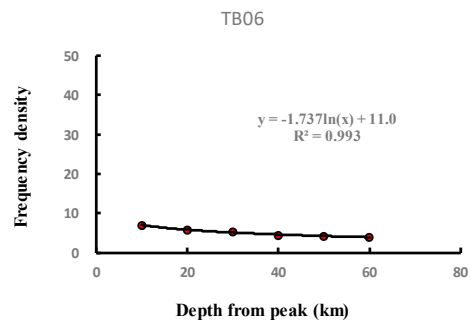
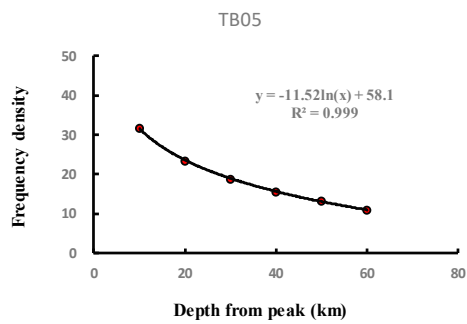
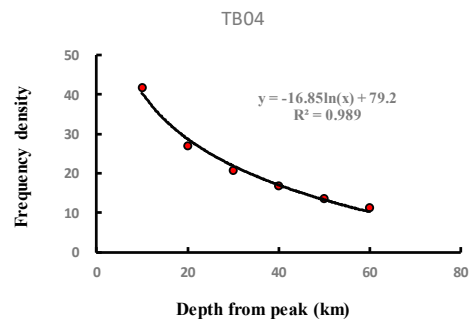
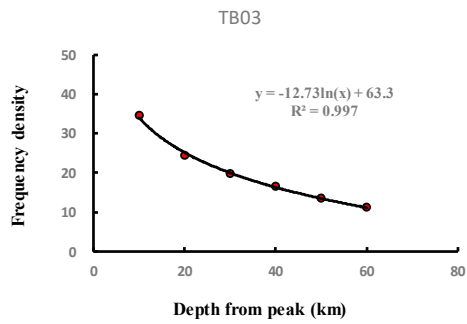
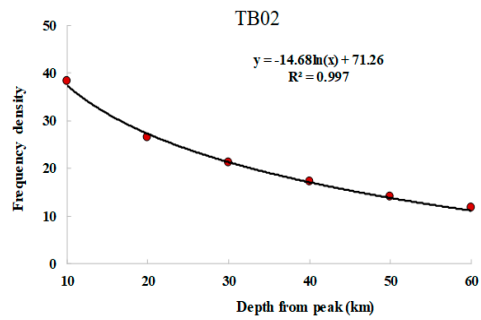
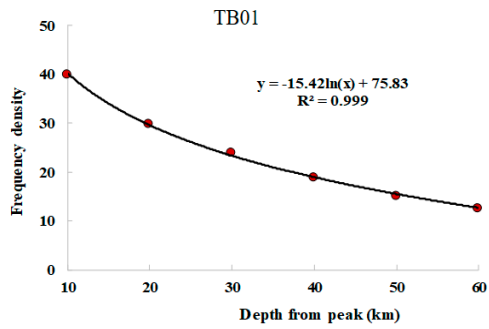
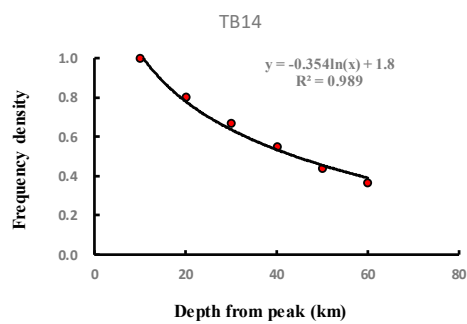
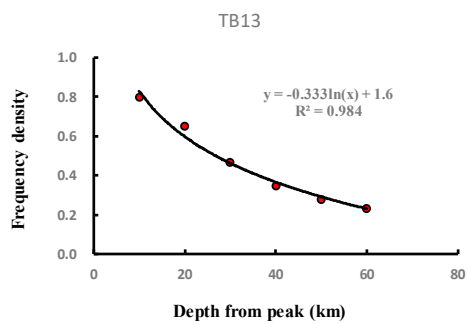
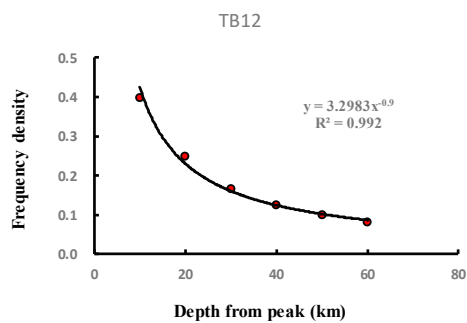
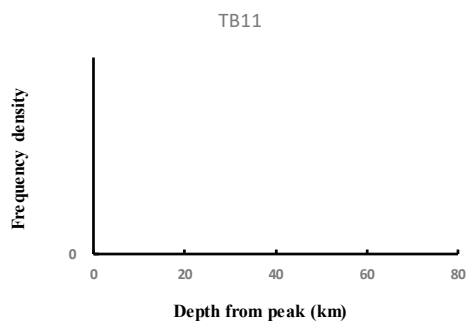
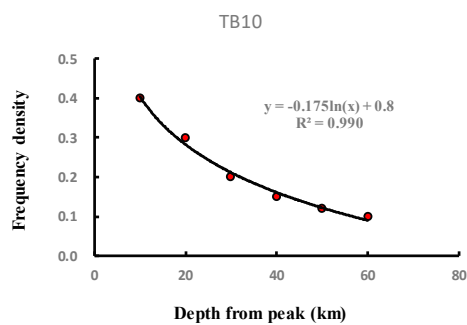
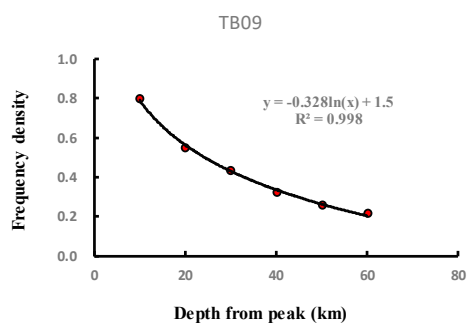
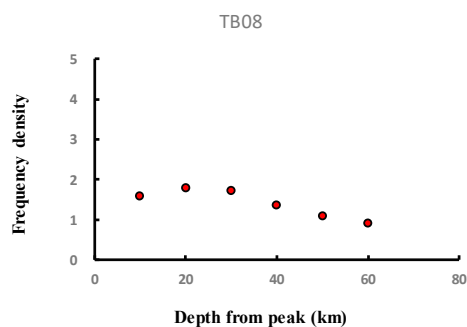
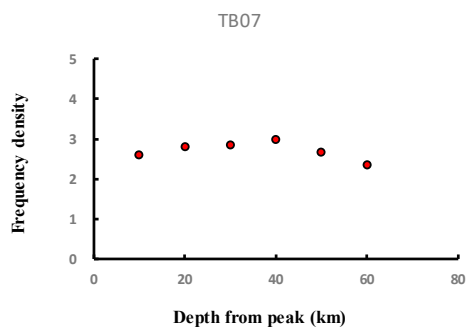
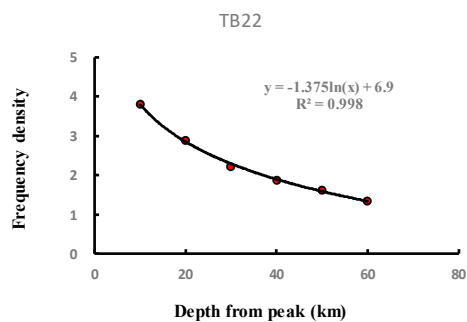
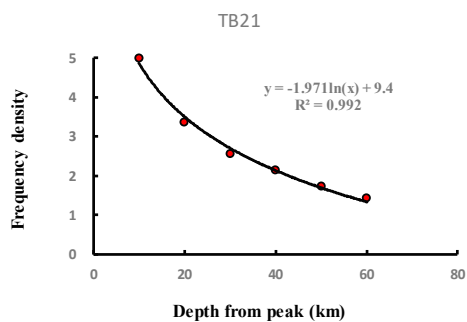
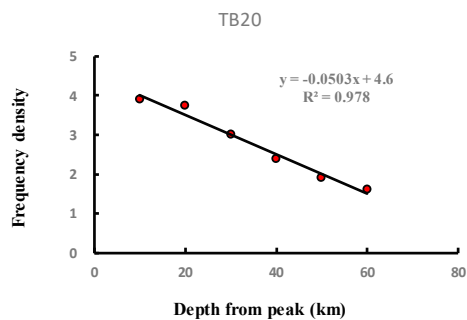
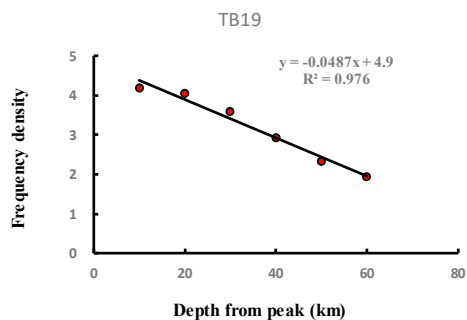
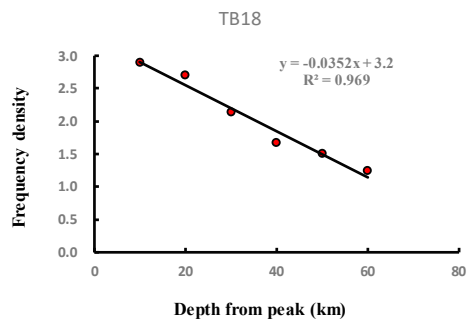
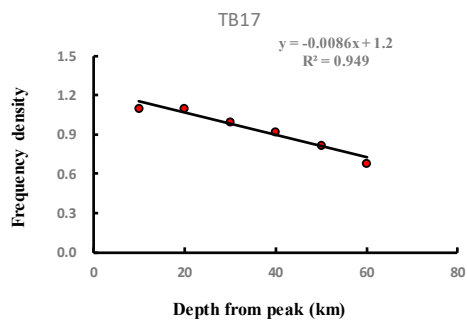
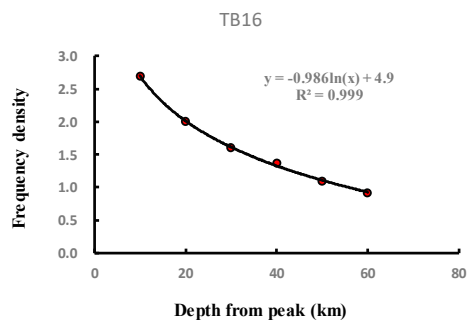
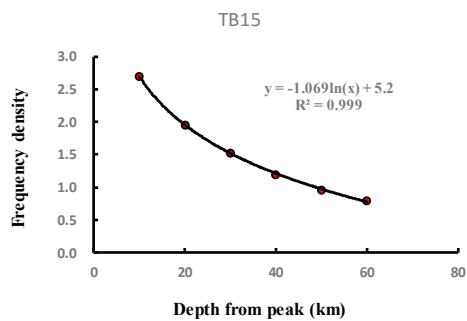
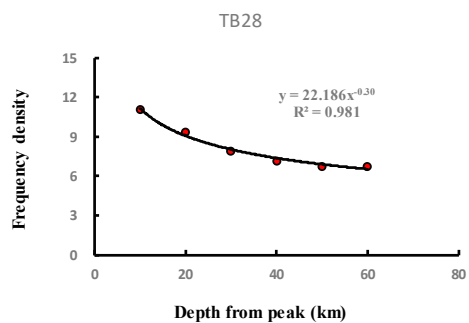
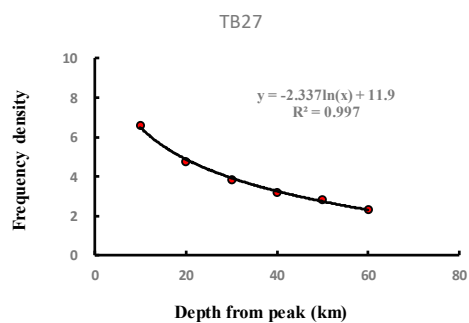
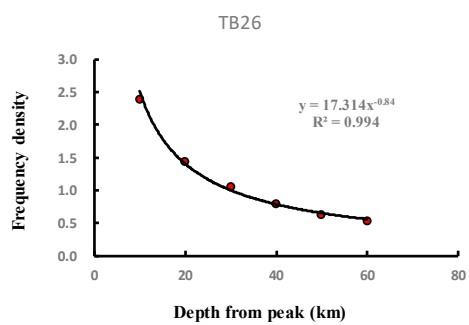
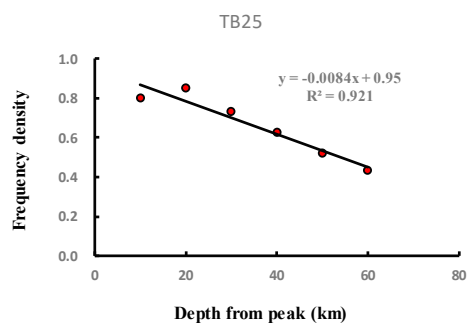
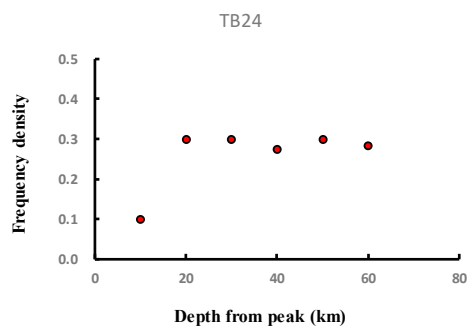
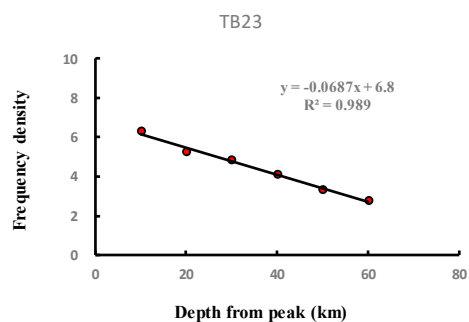


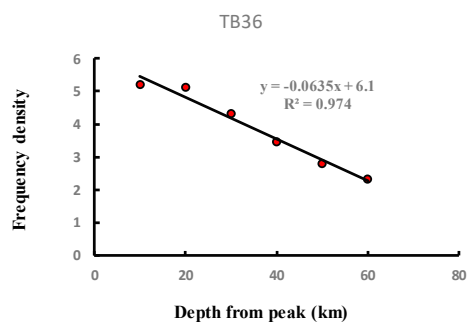
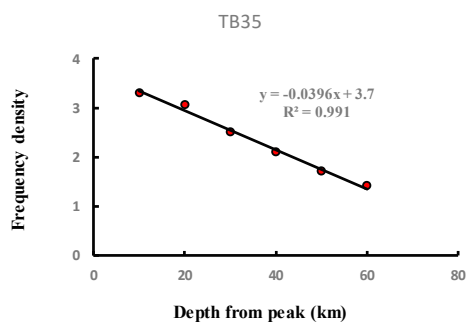
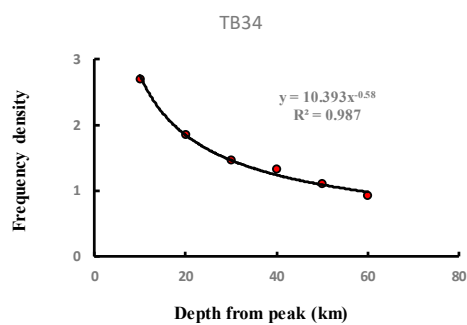
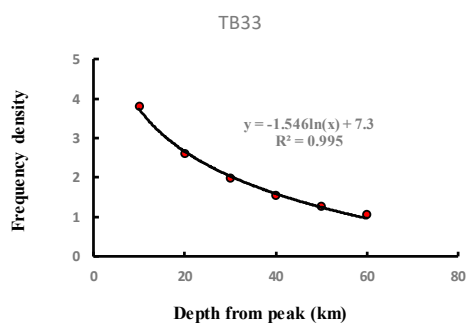
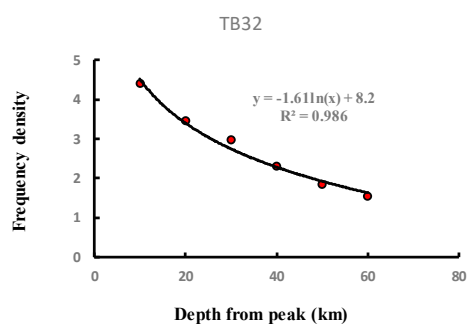
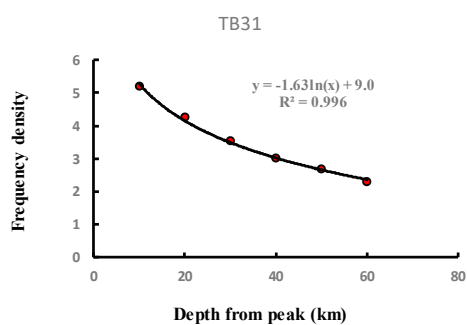
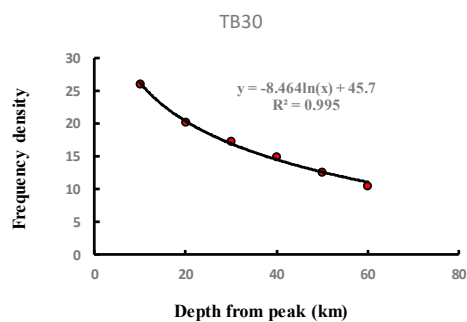
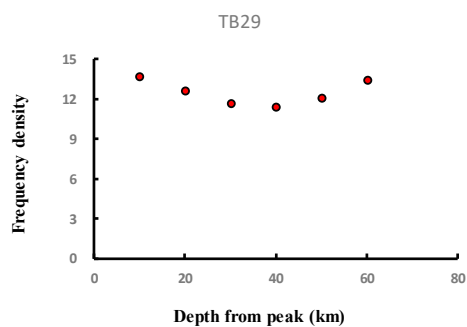
Figure S3. Frequency – depth distribution of earthquakes in north and western Pacific.

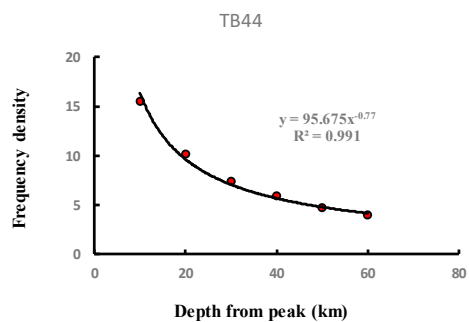
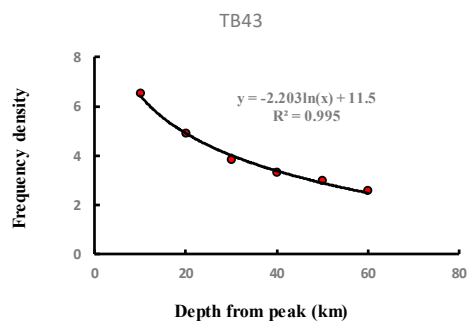
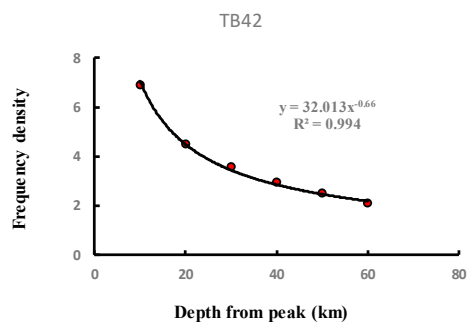
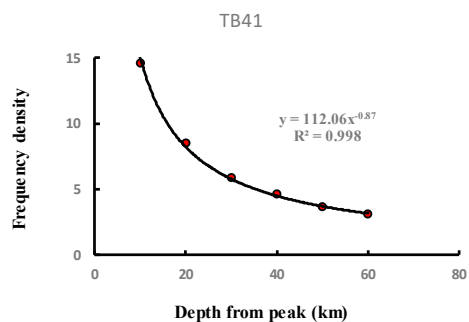
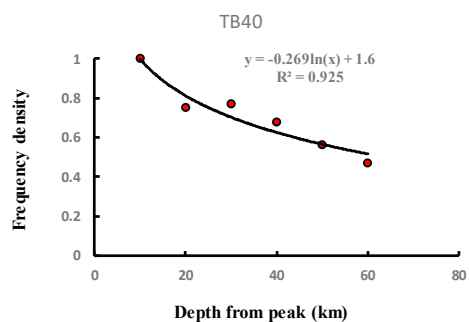
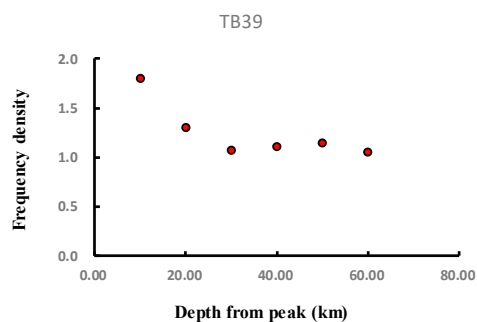
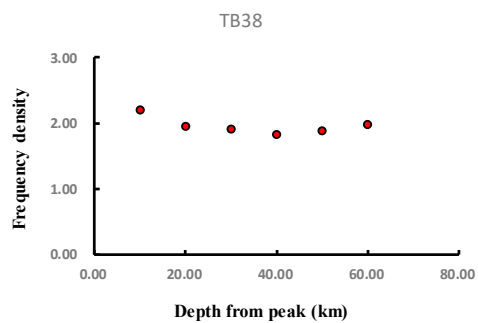
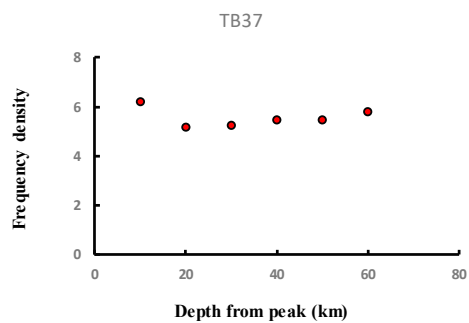


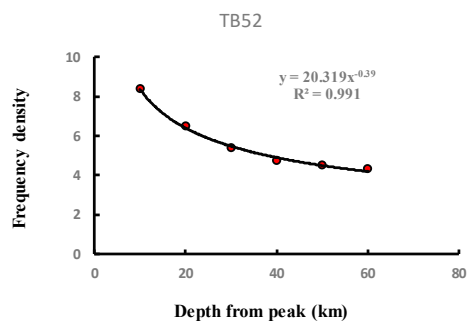
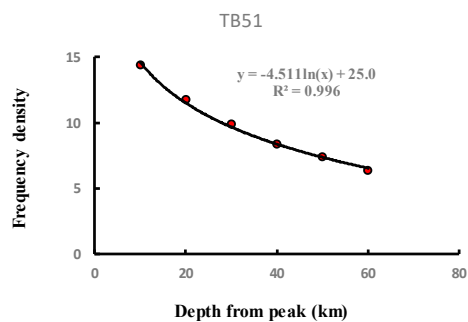
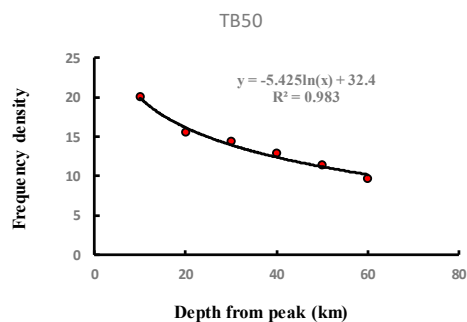
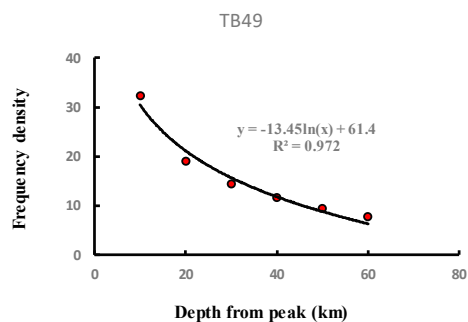
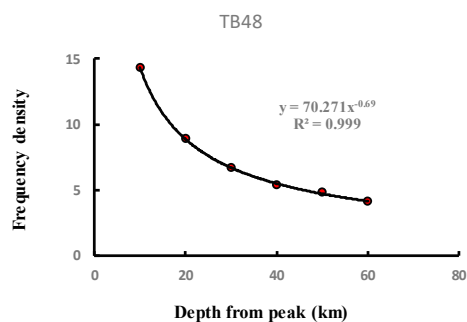
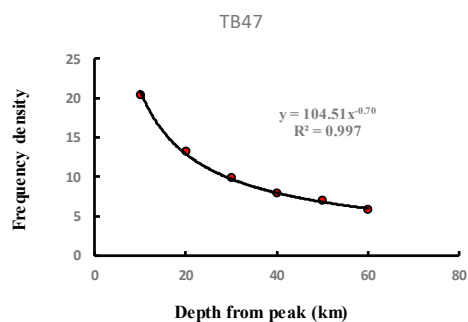
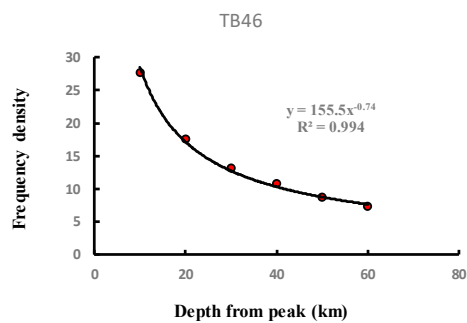
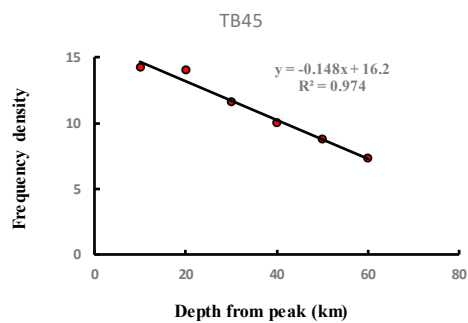












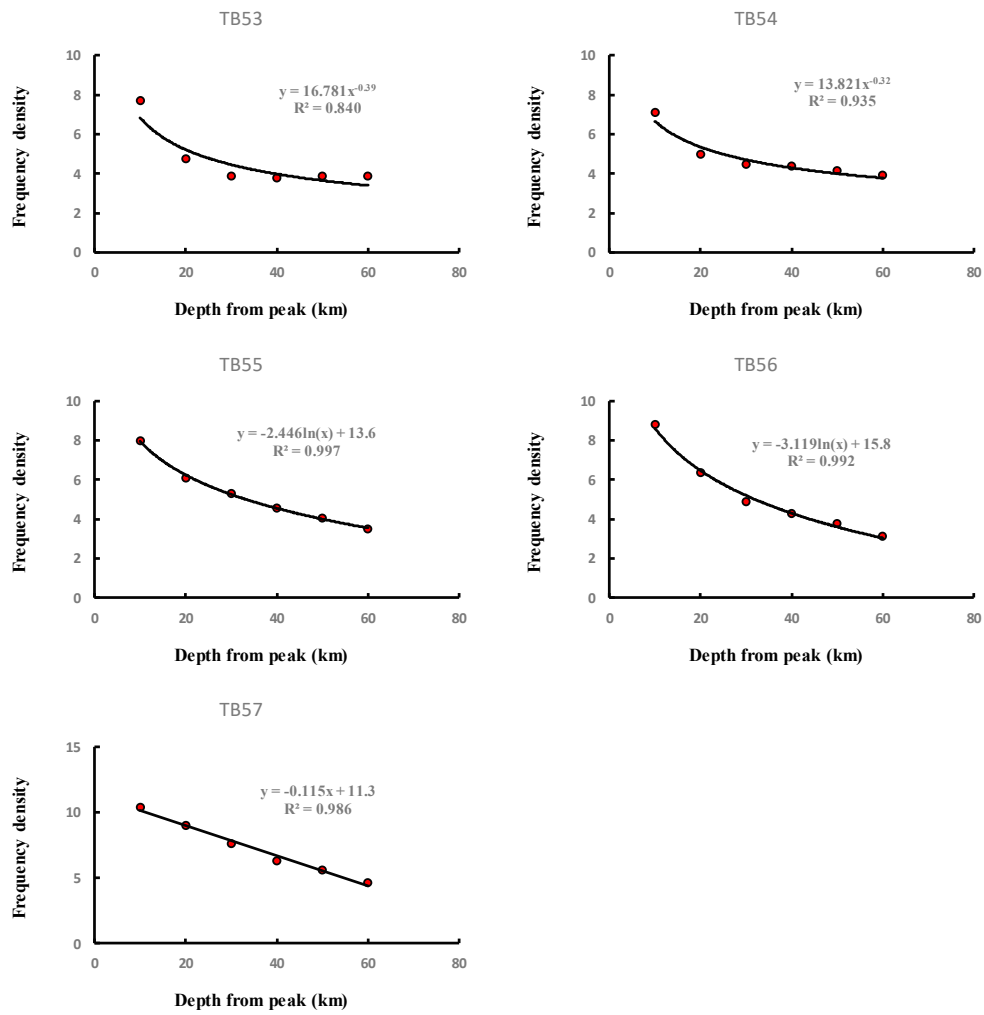


Figure S4. Frequency – depth distribution of earthquakes in Tethys Belt (TB) profiles.

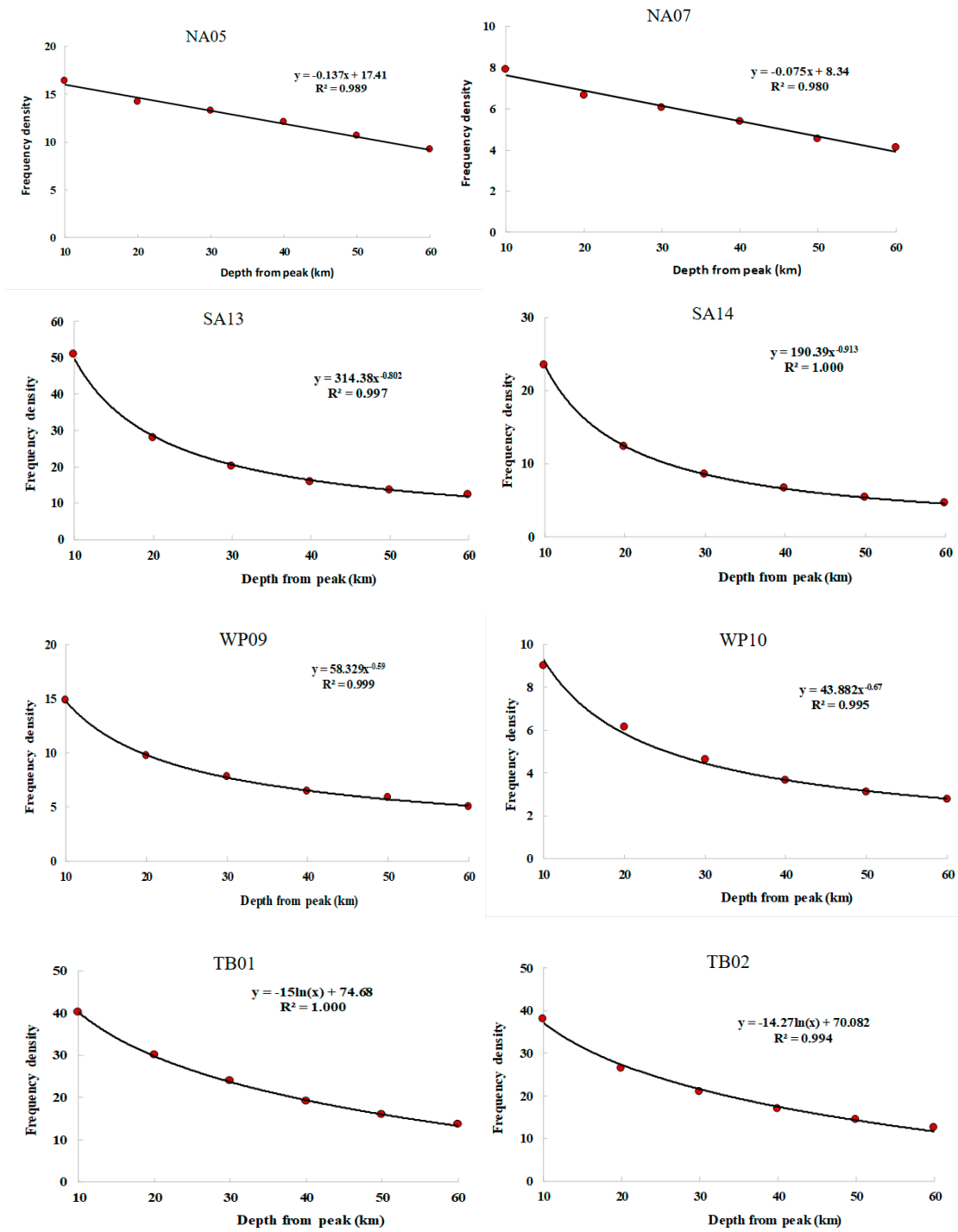


Figure S5. Frequency – depth distribution of earthquakes recalculated from the datasets used in Figure 5 except no earthquakes excluded due to errors of depths.

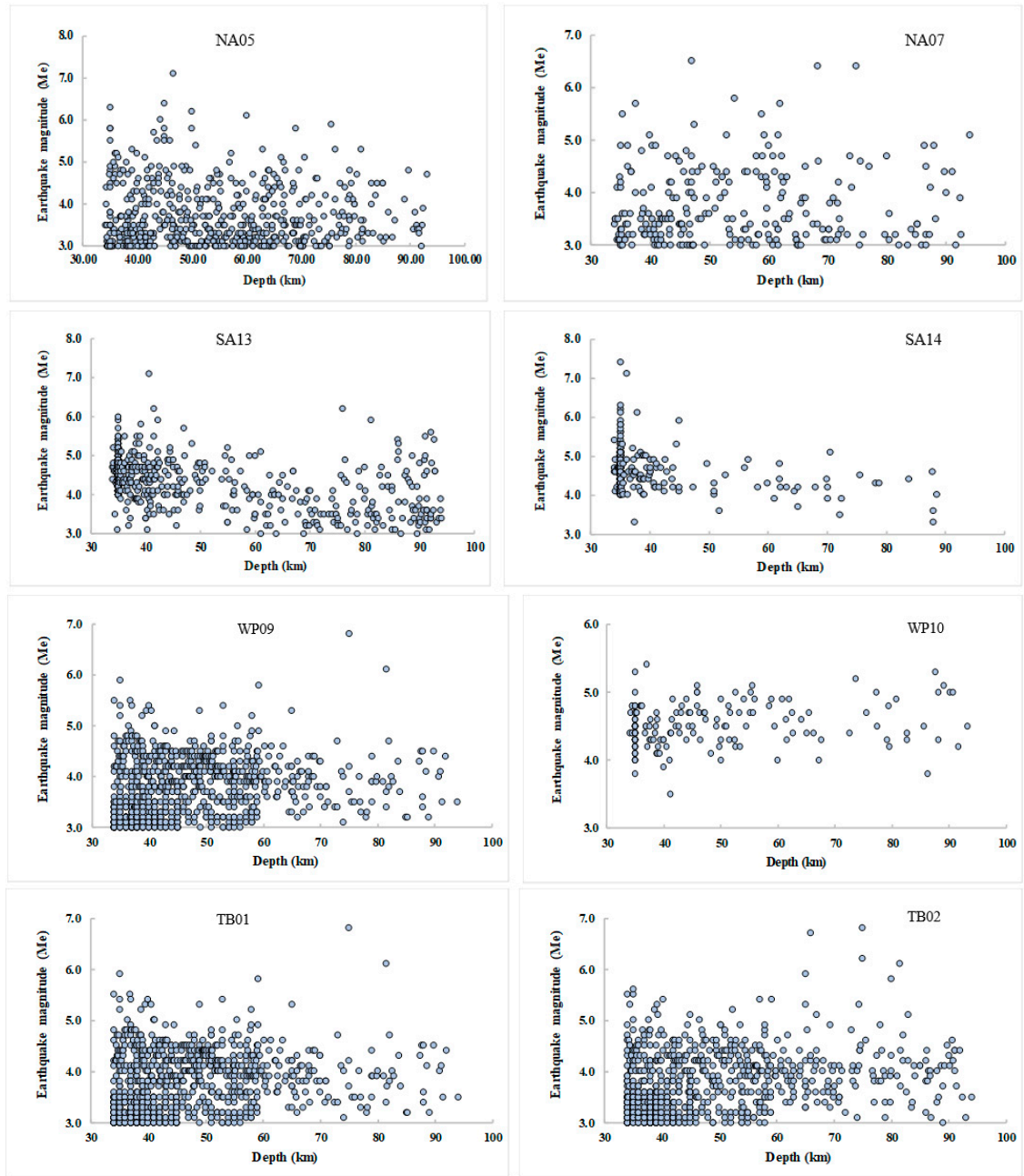


Figure S6. Figures show the distributions of earthquake magnitudes vs. depth. Datasets selected are the same as those in Figure 5.