Iberian seismicity, 1961 - 1965

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Summary. — This paper compares the seismic results corresponding to 1961-65 with those presented in several author's prior studies for the Iberian Peninsula region, which were obtained reducing to a 50 year period the available seismic material up to 1960. The present paper lists 237 earthquakes, a selection between those occurred and recorded; their epicentral coordinates, origin time, depth and magnitude from body waves; and a discussion about the seismically active quadricles on the area, regional density, epicenter display, annual frequency in steps of ¼ *m*, the parabolic adjustment for log *N*, *m*, tectonic flux and intermediate foci location related with the main tectonic features.

1961-65 is a tenth of the foresaid reduced 50 Y.P. and the present results agree with the preliminary ones, as it was expected; mainly for the following features: *a*) migration of maximal density which is Easterly; *b*) a satisfactory parabolic regression for log *N*, *m*; *c*) the cyclic appearance regarding annual frequency variation; *d*) continuation of the accumulative behaviour for the strain release curve during the present period, which began in 1954; *e*) seismicity is significatively of an intralpine character, and *f*) intermediate foci (preliminary determinations) laying out by line with both: Guadalquivir Fault, SW extension, and Alboran Sea's bottoms.

Resumen. — Este artículo compara los resultados correspondientes a 1961-65 con los presentados en otros anteriores trabajos del autor para la Región de la Península Ibérica, los cuales se dedujeron reduciendo a un período de 50 años el material disponible hasta 1960. Se da una lista con 237 terremotos, una selección entre los ocurridos y registrados; sus coordenadas epicentrales, tiempo origen profundidad y magnitud deducida de ondas internas, y se analizan las cuadrículas activas del área, la densidad regional, la situación de los epicentros, la frecuencia anua en grupos de ¼ *m*, el ajuste parabólico entre log *N* y *m*, el flujo tectónico y la localización de focos intermedios relacionada con los rasgos más salientes de la tectónica.

1961-65 es un décimo del antedicho período de 50 años y los presentes resultados concuerdan con los preliminares, como se esperaba, mayormente en los siguientes caracteres: *a*) migración de la densidad máxima desde el E; *b*) satisfactoria regresión parabólica de log N, m; *c*) apariencia cíclica en la variación de la frecuencia ánua; *d*) continuación del comportamiento acumulativo durante el presente período y para la curva de liberación de esfuerzos, que comenzó en 1954; *e*) la sismicidad tiene acusado caracter intralpino, y *f*) los focos intermedios (determinaciones preliminares) caen a lo largo de la Falla del Guadalquivir, extendida al SW, y de los fondos más profundos del mar de Alborán.

RIASSUNTO. — L'autore confronta i risultati relativi alla sismicità della Penisola Iberica dal 1961 al 1965, con quelli precedentemente pubblicati da altri Autori e ricavati da dati sismici ottenuti in 50 anni, fino al 1960.

In questa nota vengono riportati in una lista di 237 terremoti (fra quelli avvenuti e quelli registrati), le coordinate epicentrali; il tempo origine; le profondità e magnituto dedotte dalle onde spaziali; una discussione sulla quadricle sismicamente attive nella zona presa in esame; la posizione degli epicentri; la frequenza annuale in gruppi di ¼ m, l'accordo parabolico fra log N ed m; il flusso tettonico, e infine la posizione dei fuochi intermedi riferiti alle principali linee tettoniche.

I risultati ottenuti nel periodo 1961-1965 concordano — come del resto si sperava — con quelli del cinquantennio già in precedenza studiato, specialmente per le seguenti caratteristiche: *a*) migrazione della densità massima verso Est; *b*) una soddisfacente regressione del log N ed m; *c*) una apparenza ciclica della variazione annuale della frequenza; *d*) la continuità dell'andamento cumulativo della curva degli sforzi liberati nel periodo preso in esame, ed iniziato nel 1954; *e*) il carattere intralpino della sismicità; *f*) la posizione dei fuochi intermedi (determinazione preliminare), i quali cadono fra la faglia del Guadalquivir (al largo) verso SW, e i fondali molto profondi del Mare di Alboran.

1. INTRODUCTION.

The purpose of this paper is to check the present seismic results, 1961-1965, with those deduced for the " 50 year period " (*) regarding the Iberian Peninsula region, which extends 1.340,000 sq km, approximately.

The material used is quoted in the "Boletín de sismos próximos"(**) wherein issues the preliminary determinations of epicentral coordinates, origin time, focal depth and magnitude of the earthquakes occurred inside the area 35°-44°N, 10°W-5°E. Then, you have five years

(*) See references CM, SD, EF, PM, ES, MA.

(**) Which is published by the Laboratorio Central des Servicio de Sismología.

of instrumental data, one tenth to compare again the foresaid 50 Y.P., which was established reducing all material available up to 1960.

2. Located shocks.

Table I lists the earthquakes with epicenters located on the area during the lapse 1961-1965, using the records from the Spanish peninsular seismological stations and also the information from the neighbouring Portuguese, Algerian and Morocco ones. Table II quotes the remarks corresponding to Table I. They were located 237 shocks, 16.6 per cent between 1453 earthquakes in the Boletín; this percentage represents a progress regarding acceptable location, as follows:

Lapse, years	Unlocated shocks	Llocaled shocks conjectural	Acceptable	Remarks
1801–1900	38.9	60.6	0.5	(2) historical
1901–1950	68.8	23.6	7.6	(2) instrumental
1951–1960	85.5	6.9	7.6	(2) idem
1961–1965	83.4	0.9	15.7	idem

Table I and Table II are prepared as it was made in *SD* and *EF*, completing to date the summary for the earthquakes located on the area through 2365 years. Column k (kind) indicates the quality of data,

R recording data, but no complete seismic information;

E macro- and micro- epicentral determination;

M micro-determination and also magnitude from records;

C id. id. id. and epicentral intensity;

B id. id. id. and numerical error in *H*, processing a computer program (*).

Only nine earthquakes are of *B* kind: No. 3310, 3326, 3341, 3436, 3447, 3454, 3455, 3507 and 3527. These results have been deduced

(*) The program computes the standard deviation in *H* for each *h* and epicentral coordinates as input, up to a limit of 1000 km for epicentral distance.

Table I – List of the earthquakes located on the area.

Seventh epoch. 5 years.

Order	*k*	year	date	*H* (UT)	Lat N	Long	h	*m*	Int.	Localities	Notes	Map
3308	C	1961	J 8	101250	37.0	— 3.7	n	4.1	II	Granada		D13
3309	M	1961	J 13	031303	37.3	— 3.5	45	4.1		Atarfe		E13
3310	B	1961	J 19	163327	37.0	— 6.2	113	4.9	IV	S. Lucar	(.)	D08
3311	C	1961	F 10	185203	41.6	— 5.8	33	5.2	V	Zamora	6.m (.)	S09
3312	M	1961	M 11	082911	36.3	— 7.1	n	4.7		G. Cadiz	(.)	C06
3313	C	1961	M 16	073039	38.1	— 1.1	n	4.1	III	Fortuna	(.)	J18
3314	R	1961	A 5	065906	42.5	— 4.8				Santander	(BCIS)	W11
3315	M	1961	A 9	133328	37.5	— 0.3	n	4.3		C. Palos		E20
3316	C	1961	A 14	162452	38.0	— 1.2	n	4.3	III	Murcia	1.	H18
3317	M	1961	Y 29	052727	36.1	— 0.7	n	4.7		Algeria		C19
3318	R	1961	L 4	024048	38.0	— 9.0				Portugal	(BCIS)	H02
3319	C	1961	L 12	141446	37.3	— 3.7	n	4.7	IV	P. Puente	2.	E13
3320	M	1961	L 22	050922	36.7	— 5.4	n	4.5		Ubrique		D10
3321	C	1961	L 31	222833	37.3	— 3.7	n	4.4	V	Albolote	(.)	E13
3322	M	1961	G 8	104701	44.0	— 7.3	n	4.9		Vivero		X06
3323	M	1961	G 25	195950	36.3	— 2.6	n	4.7		Almeria		C15
3324	C	1961	S 3	233314	41.9	— 2.5	n	4.9	VII	Agreda	18. m (.)	S15
3325	M	1961	S 11	071916	36.8	— 9.2	n	4.8		S. Vicente		D02
3326	B	1961	S 28	222552	36.3	— 8.0	113	5.0		S. Maria	(.)	C04
3327	C	1961	O 6	032032	36.5	+ 1.2	n	4.9	VI	Orleansville	(.)	C23
3328	M	1961	O 24	195522	37.7	— 4.0	n	4.1		Martos		H12
3329	C	1961	N 12	113957	37.5	— 3.5	n	4.5	IV	Albolote		E13
3330	E	1961	N 23	044536	36.5	+ 2.8	n		V	Joinville	(BCIS)	C26
3331	M	1961	D 8	105337	38.3	— 1.9	n	4.8		Cieza		H19
3332	M	1961	D 22	120040	41.8	— 5.6	n	4.7		Zamora	2.	S09
3333	R	1962	J 7	142515	36.4	— 3.3	n			Alboran		C14
3334	R	1962	J 13	093037	36.1	— 3.3	n			Alboran		C14
3335	M	1962	J 13	093619	35.6	— 3.3	n	4.7		Alboran		B14
3336	M	1962	J 14	044531	36.4	— 3.4	n	4.4		Motril		C14
3337	M	1962	J 15	044804	36.9	— 3.5	n	3.6		Orjiva		D13
3338	M	1962	J 15	164909	36.4	— 3.4	n	4.5		Motril	1.	C13
3339	M	1962	J 17	235323	37.3	— 3.1	n	4.1		Guadix		E14
3340	M	1962	J 23	033050	37.5	— 4.5	n	4.4		Cabra		E11
3341	B	1962	J 28	032422	36.3	— 7.8	95	4.8		G. Cadiz		C06
3342	C	1962	F 11	133246	37.3	— 2.1	n	4.6	IV	Vera		E16
3343	C	1962	F 14	134815	35.4	— 3.1	n	4.8	III	Melilla	2.	A14
3344	M	1962	F 21	090241	35.5	— 3.4	n	4.4		Melilla		A14
3345	M	1962	F 21	093039	36.5	— 3.1	n	3.8		Adra		C14
3346	M	1962	M 1	221955	35.8	— 3.6	25	4.9		Alboran	1. (.)	B13
3347	R	1962	M 11	234050	39.4	— 1.8			II	Salobre	(.)	L17
3348	M	1962	M 20	000142	38.5	— 5.6	n	4.6		Badajoz		E09
3349	M	1962	A 2	144236	36.2	— 2.4	n	4.0		Alboran		C16
3350	M	1962	A 9	085256	35.7	— 9.0	33	5.1	IV	Casablanca	(.)	B02
3351	C	1962	A 16	093836	36.7	— 2.3	n	4.1		Gata		D16
3352	M	1962	A 18	084341	37.2	— 3.5	n	3.5		S. Nevada		E13

(Tab. I, cont.)

Order	*k*	year	date	*H* (UT)	Lat N	Long	h	*m*	Int.	Localities	Notes		Map
3353	C	1962	A 25	213352	37.2	— 3.5	n	4.5	IV	S. Nevada	1.	(.)	E13
3354	C	1962	A 26	081313	37.3	— 3.5	n	3.8	III	Iznalloz			E13
3355	R	1962	Y 2	065200	42.1	+ 2.6				Amer			T26
3356	C	1962	Y 3	232725	43.6	— 7.3	33	5.2	VI	Vivero	m	(.)	X06
3357	M	1962	Y 7	040209	36.5	— 3.6	n	3.6		Alboran			C13
3358	M	1962	Y 8	083541	37.1	— 3.5	n	3.6		S. Nevada			E13
3359	M	1962	Y 12	005202	36.7	— 3.5	n	3.7		Motril			D13
3360	C	1962	U 1	195917	36.4	—3.0	n	4.3	II	Adra	3.	(.)	C14
3361	C	1962	U 9	055946	42.0	+ 0.7	n	4.7	V	Ribagorzana	m		S22
3362	M	1962	L 15	185615	36.2	— 0.8	n	4.6		Cartagena			C19
3363	M	1962	L 16	162156	37.3	— 4.7	n	3.9		Cabra			E11
3364	R	1962	G 14	221405	36.6	— 6.0			III	Arcos		(.)	D08
3365	M	1962	G 14	223837	36.6	— 6.0	n	4.3		Arcos	3.		D08
3366	M	1962	G 25	195851	36.6	+ 0.9	33	4.6		Algeria		(.)	D22
3367	R	1962	G 26	122420	37.4	— 2.3				Jaen		(.)	E14
3368	M	1962	G 26	163052	36.7	+ 1.3	15	4.8		Algeria		(.)	D23
3369	M	1962	G 29	164853	37.2	— 4.1	n	4.2		Loja			E12
3370	M	1962	S 4	151144	36.8	— 9.0	33	5.0		S. Vicente		(.)	D02
3371	M	1962	S 9	014713	36.3	— 6.7	n	3.7		G. Cadiz			C07
3372	C	1962	S 11	071502	36.7	— 2.6	n	3.7	II	Almeria			D15
3373	M	1962	S 16	005101	39.3	— 2.2	n	4.2		La Roda	1.		L16
3374	M	1962	S 22	232203	37.1	— 3.5	n	3.4		S. Nevada	2.		E13
3375	M	1962	S 27	034242	36.6	— 3.2	n	3.7		Albuñol			D14
3376	M	1962	S 28	231801	36.3	— 3.0	n	4.0		Adra			C14
3377	C	1962	O 8	185145	36.7	— 1.5	n	4.9	III	S. Almeria			D17
3378	M	1962	O 14	002300	37.1	— 3.6	n	3.3		Padul			E13
3379	M	1962	O 29	152228	37.0	— 3.6	n	3.5		Durcal			D13
3380	R	1962	O 30	070110	37.1	— 2.2				N. Almeria		(.)	E16
3381	C	1962	N 2	180653	42.3	+ 2.1		5.2	V	Ripoll	2.m		T25
3382	M	1962	N 5	082950	37.5	— 2.8	n	4.7		Baza			E15
3383	C	1962	N 22	184539	38.2	— 0.5	n	3.9	IV	Tabarca	m		J19
3384	R	1962	D 4	133145	36.8	— 2.1				C. Gata		(.)	D16
3385	C	1962	D 31	005259	41.9	+ 1.0	n	5.0	IV	Tremp	1.m	(.)	S22
3386	R	1963	J 11	085355	36.8	— 2.1				C. Gata		(.)	D16
3387	C	1963	J 15	090654	38.3	— 1.1	n	4.2	V	Abanilla	3.m		J18
3388	C	1963	J 19	205029	38.3	— 1.1	n	4.1	VI	Abanilla	m		J18
3389	C	1963	J 25	113301	38.2	— 0.5	n	4.0	IV	S. Pola	m		J19
3390	M	1963	J 26	134706	35.9	— 3.8	33	4.5		Alboran			B13
3391	M	1963	J 27	161023	36.7	— 6.0	33	4.2		Arcos			D08
3392	M	1963	J 31	180225	37.4	— 2.0	n	3.9		Huercal			E16
3393	R	1963	F 10	210220	38.2	— 0.5				S. Pola		(.)	J19
3394	M	1963	M 18	115033	39.1	— 0.4	n	4.5		Jativa			L20
3395	M	1963	M 28	042925	35.8	— 4.9	n	4.7		Alboran			B11
3396	R	1963	M 28	210515	38.0	— 1.0				Novelda	2.	(.)	H18
3397	M	1963	M 31	145807	35.8	— 8.9	33	5.2		G. Cadiz		(.)	B03
3398	R	1963	A 3	130605	38.0	— 0.7				Torrevieja		(.)	H19
3399	M	1963	A 21	053158	35.8	— 4.2	n	4.4		Alboran			B12
3400	M	1963	Y 10	195940	37.1	— 2.8	n	3.9		Paterna			E15

(Tab. I, cont.)

Order	*k*	year	date	*H* (UT)	Lat N	Long	h	*m*	Int.	Localities	Notes	Map
3401	C	1963	Y 30	015448	37.7	— 2.0	n	4.7		Velez-Rubio	m (.)	H16
3402	C	1963	U 26	102705	35.9	— 3.2	n	5.0	III	Melilla	8. (.)	B14
3403	R	1963	U 27	114520	37.2	— 2.2			IV	Olula	(.)	E16
3404	M	1963	U 27	224347	37.1	— 3.2	n	4.1		Olula		E16
3405	M	1963	L 25	014212	35.8	— 3.4	n	4.2		Alboran		B14
3406	M	1963	G 1	014928	37.0	— 8.0	33	4.3		S. Vicente		D04
3407	M	1963	G 2	104919	35.0	— 8.6	33	5.1		W.Marruecos	(.)	A03
3408	M	1963	G 19	183236	38.3	— 8.7	n	4.5		W. Roca		J03
3409	M	1963	G 24	012420	35.7	— 3.6	n	4.0		Alboran		B13
3410	M	1963	G 24	114141	4.28	+ 0.1	n	4.4		Pirineos		U21
3411	M	1963	G 30	000430	36.6	— 2.0	n	3.9		Almeria	1.	D16
3412	M	1963	S 8	004401	35.6	— 4.0	n	4.1		Alboran		B12
3413	M	1963	S 11	164855	36.8	— 3.0	n	4.1		Berja		D14
3414	R	1963	S 13	050440	41.6	+ 1.4				Urgel	5. (.)	S23
3415	M	1963	S 16	145207	37.1	— 3.5	n	3.8		S. Nevada		E13
3416	M	1963	S 25	222205	39.2	+ 0.2	n	4.6		G. Valencia		L21
3417	R	1963	S 26	220115	36.7	— 2.8				Roquetas	(.)	D15
3418	M	1963	S 29	123150	37.4	— 4.1	n	4.2		Montefrio		E12
3419	M	1963	O 1	071558	37.7	— 2.5	n	4.1		Orce		H15
3420	M	1963	O 6	113936	37.3	— 4.0	n	4.1		Montefrio		E12
3421	M	1963	O 13	230658	37.0	— 4.7	n	4.0		Bobadilla		D11
3422	M	1963	O 15	181227	37.2	— 4.6	n	4.2		Alameda		E11
3423	M	1963	O 24	035022	37.0	— 4.6	n	4.2		Antequera		D11
3424	M	1963	N 2	124518	35.4	— 4.6	n	4.8		Alboran		A11
3425	M	1963	N 18	053257	35.8	— 2.7	n	4.4		N. Melilla		B15
3426	M	1963	N 18	190919	38.0	0	n	4.2		Mediterran.		H20
3427	M	1963	N 19	224401	36.4	— 4.0	n	3.8		Alboran		C12
3428	M	1963	N 25	035421	37.1	— 3.9	n	4.2		Alhama		E13
3429	M	1963	N 26	012138	37.0	— 8.0	n	4.2		S. Maria		D04
3430	C	1964	J 12	212453	37.2	— 3.8	n	4.7	IV	Lachar		E13
3431	M	1964	J 13	044330	38.2	— 9.3	n	4.5		SW Espichel		J02
3432	C	1964	J 29	014751	37.3	— 3.7	n	4.7	VI	P. Puente	2.	E13
3433	M	1964	F 19	024448	35.7	— 3.3	n	4.3		Alboran		B14
3434	C	1964	M 1	101959	37.8	— 1.5	n	4.4	III	Aledo		H17
3435	M	1964	M 5	085455	37.1	— 3.3	n	3.8		S. Nevada		E14
3436	B	1964	M 15	223026	36.0	— 7.7	100	6.2	VIII	G. Cadiz	9.m (.)	B05
3437	R	1964	M 20	063940	37.7	— 1.8				Lorca	(.)	H17
3438	M	1964	A 2	160231	38.2	— 1.1	n	4.2		Abanilla		J18
3439	M	1964	A 3	022716	37.0	— 4.7	n	4.1		Bobadilla		D11
3440	C	1964	A 3	122833	38.2	— 1.1	n	4.4	V	Abanilla		J18
3441	M	1964	A 9	222953	35.8	— 4.3	n	4.2		Alboran		B12
3442	M	1964	A 11	185653	38.1	— 1.0	n	4.1		Callosa		J18
3443	M	1964	A 14	102143	38.2	— 1.0	n	4.4		Abanilla		J18
3444	M	1964	A 15	084026	38.4	— 1.8	n	4.1		D. Ines		J17
3445	C	1964	A 17	185302	37.2	— 3.7	n	4.2	II	S. Fe		E13
3446	M	1964	A 21	144047	36.4	+ 3.3	n	4.4		Tablat		C27
3447	B	1964	A 26	101602	36.2	— 4.6	65	4.3		Alboran		B11
3448	M	1964	A 26	202851	36.3	— 4.1	n	4.3		Mediterran.		C12

(Tab. I, cont.)

Order	*k*	year	date	*H* (UT)	Lat N	Long	h	*m*	Int.	Localities	Notes	Map
3449	M	1964	A 27	023441	36.5	— 1.5	n	4.4		Mediterran.		C17
3450	M	1964	A 30	010357	37.0	— 4.8	n	4.2		Bobadilla	2.	D11
3451	M	1964	Y 3	233002	37.5	— 2.1	n	4.2		Albox		E16
3452	M	1964	Y 9	051901	38.2	— 1.0	n	4.3		Abanilla		J18
3453	M	1964	Y 13	134621	35.8	— 1.7	n	4.7		Mediterran.	(.)	B17
3454	B	1964	Y 13	173227	35.8	— 5.0	95	4.7		Alboran	(.)	B10
3455	B	1964	U 9	023332	37.8	— 2.5	5	5.2	VII	Huescar	13. m (.)	H15
3456	C	1964	U 11	225014	37.8	— 2.6	n	4.3	III	Galera	(.)	H15
3457	M	1964	U 12	093336	37.7	— 2.5	n	3.9		Orce	(.)	H15
3458	M	1964	U 13	160048	37.7	— 2.3	n	4.0		Orce		H16
3459	M	1964	U 18	112610	37.5	— 3.6	n	3.9		Campotejar	1.	E13
3460	M	1964	U 21	024405	37.8	— 3.6	n	3.8		M. Real		H13
3461	M	1964	U 26	235048	37.3	— 2.2	n	4.3		Albanchez	1.	E16
3462	M	1964	U 27	002336	37.8	— 2.5	n	4.1		Orce	3. (.)	H15
3463	M	1964	U 29	003130	37.8	— 2.5	n	4.2		Orce		H15
3464	C	1964	L 3	213531	37.9	— 1.5	n	4.0	IV	Pliego	m	H17
3465	C	1964	L 13	122506	37.1	— 2.0	n	4.7	V	Turre	(.)	E16
3466	M	1964	L 15	094906	35.5	+ 4.3	33	4.9		Setif	(.)	A29
3467	R	1964	L 15	110408	35.3	— 0.3				Oran	(BCIS)	A20
3468	M	1964	L 19	020707	37.2	— 5.5	n	3.0		Moron		E09
3469	M	1964	L 28	220942	42.7	— 1.5	n	4.2		Pamplona		U17
3470	R	1964	G 15	064520	36.7	— 4.3				Malaga	3. (.)	D12
3471	M	1964	G 17	114019	37.6	— 2.8	n	4.0		Baza		H15
3472	C	1964	G 29	024522	43.0	+ 0.1	n	4.9	VI	Bagnares	(.)	U21
3473	M	1964	S 1	145400	36.9	— 5.3	n	3.9		Algodonales	4.	D10
3474	C	1964	S 6	023433	36.9	— 4.4	n	4.1	IV	Casabermeja	21.	D12
3475	C	1964	S 9	093943	37.0	— 3.5	15	4.8	VI	Padul	21. (.)	D13
3476	C	1964	S 9	124403	36.9	— 4.4	n	4.1	IV	Casabermeja	4. (.)	D12
3477	R	1964	S 11	091315	36.9	— 4.7			III	Abdalagis	3.	D11
3478	R	1964	S 20	092030	36.7	— 4.3			III	Malaga	(.)	D12
3479	M	1964	S 29	051928	37.4	— 2.0	n	3.9		Huercal		E16
3480	M	1964	O 2	093925	35.6	+ 0.1	n	4.2		Perregaux		B21
3481	M	1964	O 3	052312	37.1	— 4.6	n	4.1		Antequera		E11
3482	M	1964	O 10	021920	37.4	— 2.7	n	4.3		Artificial		E15
3483	M	1964	O 17	002951	37.8	— 2,5	n	3.9		Orce		H15
3484	E	1964	O 21	195751	36.3	+ 4.5	33		VII	Bibans	(BCIS) (.)	C29
3485	C	1964	N 2	113948	36.6	— 2.6	n	4.1	III	S. Almeria	m (.)	D15
3486	M	a964	N 6	045857	37.9	— 2.3	n	4.1		Topares		H16
3487	R	1964	N 9	155545	36.6	— 9.6				S. Vicente	(BCIS) (.)	D01
3488	M	1964	N 23	023750	36.9	— 4.4	n	4.1		Casabermeja	(.)	D12
3489	C	1964	N 26	231459	38.8	— 0.4	n	4.5	V	Castell	m (.)	K20
3490	M	1964	D 21	000459	39.4	— 0.2	n	4.2		Valencia		L20
3491	M	1964	D 23	064712	36.9	— 4.3	n	4.8		Colmenar	14. (.)	D12
3492	M	1964	D 29	010056	37.2	— 4.2	n	4.8		Loja	1. (.)	E12
3493	M	1965	J 1	173231	35.4	+ 4.5	n	4.9		M'sila		A29
3494	C	1965	J 1	213826	35.4	+ 4.5	n	5.6	VIII	M'sila	2. (.)	A29
3495	M	1965	J 9	083034	36.5	— 4.3	n	4.5		S. Malaga		C12
3496	M	1965	J 25	165309	36.7	— 2.0	n	9.5		C. Gata		D16

(Tab. I, cont.)

Order	k	year	date	H (UT)	Lat N	Long	h	m	Int.	Localities	Notes	Map
3497	M	1965	F 7	035807	36.7	— 3.6	n	3.9		Motril		D13
3498	M	1965	F 20	185806	36.2	— 5.2	n	4.3		Gibraltar		C10
3499	M	1965	F 20	045509	36.2	— 5.2	n	4.6		Gibraltar		C10
3500	M	1965	M 12	213103	37.1	— 2.3	n	3.7		Tabernas		E16
3501	M	1965	M 18	203104	43.3	— 7.3	n	4.1		Pastoriza		W06
3502	M	1965	A 5	061631	37.7	— 2.4	n	4.3		Galera	(.)	H16
3503	M	1965	A 6	173937	37.9	— 2.3	n	4.5		Huescar	(.)	H16
3504	M	1965	A 14	180517	35.3	— 5.7	n	4.3		Jemis	(.)	A09
3505	R	1965	A 19	030758	35.4	— 4.3	n			Rif		A12
3506	M	1965	Y 1	094733	38.0	— 3.8	n	4.3		Mengibar		H13
3507	B	1965	Y 6	191749	36.0	— 7.9	80	4.4		G. Cadiz		B05
3508	R	1965	Y 9	125736	43.5	— 3.5				N. Santan.	(BCIS)	W13
3509	M	1965	Y 20	205515	36.1	— 3.2	n	3.7		Alboran		C14
3510	M	1965	Y 28	163829	36.1	— 3.2	n	4.3		Alboran		C14
3511	M	1965	Y 30	115958	36.1	— 3.2	n	4.0		Alboran		C14
3512	M	1965	U 5	022153	37.7	— 3.2	n	3.8		Cabra		H14
3513	R	1965	U 9	214610	36.6	— 4.2			V	Alboran	(.)	D12
3514	M	1965	U 24	032858	37.5	— 2.5	n	3.8		S. Lucar		E15
3515	M	1965	U 29	152634	35.6	— 4.7	n	4.1		Alboran		B11
3516	M	1965	L 3	113616	38.5	— 4.5	n	3.7		Alcudia		J11
3517	M	1965	L 5	133550	37.7	— 1.3	n	4.0		Mazarron		H18
3518	R	1965	L 6	170049	36.2	+ 3.6	n			Aumale	(.)	C28
3519	R	1965	L 8	032132	42.3	+ 1.6	n			Cadí	(.)	T24
3520	M	1965	L 15	073702	37.3	— 3.7	n	4.1		P. Puente		E13
3521	M	1965	L 18	034748	38.4	— 1.9	n	3.7		Ferez		J17
3522	M	1965	L 18	225532	38.4	— 1.9	n	4.1		Ferez		J17
3523	R	1965	L 31	085941	42.4	— 2.4	n			Logroño		T16
3524	M	1965	G 3	084000	37.7	— 2.3	n	4.3		Maria		H16
3525	M	1965	G 7	212936	36.4	— 3.2	n	4.1		Alboran		C14
3526	R	1965	G 22	154306	37.1	— 2.2	n			Sorbas	2.	E16
3527	B	1965	S 7	061703	35.5	+ 3.0	(113)	4.4	VII	Bou Saada	(.)	A26
3528	M	1965	O 5	071131	38.4	— 1.9	n	4.3		Ferez	(.)	J17
3529	M	1965	O 8	120751	38.4	— 1.8	n	4.3		Isso	(.)	J17
3530	M	1965	O 8	132253	38,4	— 1.8	n	4.3		Isso	(.)	J17
3531	M	1965	O 8	141002	38.3	— 1.9	n	4.6		Ferez	(.)	J17
3532	M	1965	O 9	045607	38.4	— 1.9	n	4.2		Ferez	(.)	J17
3533	M	1965	O 21	132804	38.4	— 1.8	n	4.0		Isso		J17
3534	M	1965	O 23	013652	36.7	— 5.4	n	3.8		Grazalema		D10
3535	R	1965	N 3	151206	35.5	— 3.5	n			Alboran	(BCIS) (.)	A13
3536	R	1965	N 8	230420	35.7	+ 4.6			VI	M'sila	(BCIS)	B30
3537	M	1965	N 9	142205	35.1	— 3.5	n	4.1		Rif		A13
3538	R	1965	N 15	062648	36.6	+ 4.6				Akbou	(BCIS)	D30
3539	M	1965	N 27	213742	39.3	— 1.4	n	4.0		Casas Ibañez		L18
3540	M	1965	N 28	133811	37,1	— 3.6	n	4.4		Padul	(.)	E13
3541	M	1962	D 1	181133	36.1	— 7.5	n	4.0		G Cadiz		C05
3542	M	1965	D 11	025711	38.4	— 1.9	n	4.2		Cenajo		J17
3543	M	1965	D 12	144059	37.3	— 3.2	n	3.9		Guadix		E14
3544	M	1965	D 26	051916	38.5	— 5.5	n	4.5		Zaucejo		J09

(see (SD) to symbols); *h* = n, normal (< 33 km); m = macroseismic information.

Table II – Notes quoted in Table I.

Order.

3311. BCIS 41.5 — 6.3
3312. BCIS 36.2 — 6.8
3313. BCIS 38.3 — 1.3
3321. BCIS 37.3 — 3.8
3324. BCIS 41.8 — 2.5
3326. Lisboa 36.5 — 8.7
3327. BCIS 36.5 + 1.2

3346. Alicante 35.9 — 3.6, BCIS 37.3 — 4.0, USCGS 37.3 — 4.9 $h = 25$, LCIS $h = n$
3347. conjectural
3350. BCIS 35.3 — 9.8
3356. BCIS 43.6 — 5.3
3360. BCIS 36.3 — 4.3
3364. conjectural
3366. USCGS 36.7 + 1.6, $h = 33$, LCSS $h = 33$

3367. conjectural
3368. USCGS 36.5 + 1.6 $h = 15$, LCSS $h = 33$
3370. USCGS 36.5 — 9.0 $h = 33$, LCSS $h = 33$
3380. conjectural
3384. conjectural
3385. BCIS 42.0 + 0.5
3386. conjectural

3393. conjectural
3396. conjectural
3397. USCGS 35.1 — 9.3 $h = 33$, BCIS 35.5 — 8.2
3398. conjectural
3401. BCIS 37.7 — 2.5
3402. BCIS 36.0 — 4.2, USCGS 35.3 — 3.7 $h = 33$ $m = 4.6$
3403. conjectural

3407. USCGS 34.7 — 8.9 $h = 33$.
3414. conjectural
3417. conjectural
3436. BCIS 36.0 — 7.5, USCGS 36.2 — 7.6 $h = 27$ $m = 6.2$
3437. conjectural
3453. BCIS 35.4 — 1.9
3454. BCIS 36.4 — 5.1

3455. BCIS 37.6 — 2.4
3456. BCIS 37.7 — 2.6
3457. BCIS 37.7 — 2.6
3462. BCIS 37.6 — 2.5

(Table II, cont.)

3465.	BCIS 36.7 — 2.3
3466.	BCIS 35.5 — 4.3
3470.	conjectural
3472.	conjectural
3475.	USCGS 37.5 — 3.7 h = 15, BCIS 37.3 — 3.8
3476.	BCIS 36.8 — 4.5
3478.	conjectural
3484.	USCGS 36.4 + 4.3 h = 33
3485.	BCIS 36.8 — 3.0
3487.	BCIS, only
3488.	BCIS 36.6 — 4.3
3489.	BCIS 38.8 — 0.3
3491.	BCIS 36.8 — 4.3
3492.	BCIS 37.1 — 4.2
3494.	BCIS 35.7 + 4.4, USCGS 35.8 + 4.5 h = 33
3502.	BCIS 37.8 — 2.5
3503.	BCIS 37.8 — 2.5
3504.	BCIS 35.4 — 6.2, Ifrane 35.0 — 6.0
3513.	conjectural
3518.	BCIS 36.2 + 3.7
3521.	BCIS 42.2 + 2.3
3527.	USCGS. 35.3 + 4.4 h = 33, BCIS 35.2 + 4.5
3528.	BCIS 38.4 — 1.7
3529.	BCIS 38.4 — 1.7
3530.	BCIS 38.4 — 1.7
3531.	BCIS 38.4 — 1.7
3532.	BCIS 38.4 — 1,7
3535.	Ifrane
3540.	BICS 37.3 — 3.8

by means of the computer program EPICO. We plan to apply the same method to every shocks with recording data in six or more stations.

By quality, it is possible to take three groups of shocks, regarding its epicentral location:

conjectural	*Rj*			13 shocks
acceptable	*Rc*, *E*, *M*, *C*	approx. error $^1/_4$ dg	224	
	B	st. dev. for $H \leqslant 2$ sec		237

Exception made for *B* kind, the error quota is unknown in the epicentral location as a consequence the uncertain focal depth. The preliminary epicentral determinations have been made in the *LCSS* by J. L. Flores-Calderón, who applied systematically a graphic method on a map scale 1:2.000.000, using values deduced from the Polumb and Evison travel-time tables. Magnitude for the M, C, B shocks has been computed by means the formula explained in CM, using body waves, which is

$$m = 0.63 \log A/T + 1.207 \log \Delta^{\circ} + 4.175 + dm\,. \qquad [1]$$

Recently, in MA, a new formula was deduced to compute m from S waves and periods close and higher than 0.8 sec. Differences between these last values and those obtained from [1] are lower than 1/3 unities of magnitude, approximately. Wherefore, it is acceptable now to group shocks of 1/4 m in order to make statistical studies.

3. Seismic active quadricles.

The area was divided (see SD) with a net of parallels and meridians of 1/2 geographical degrees, identifying everyone by means an alphameric code: a letter to latitude and two ciphers to longitude, respectively. Table III lists the seismic active quadricles and the chronological ordinal number for the corresponding located shocks. Migration was advised during prior studies; even, secondary maximum for 1801-1960 becames primary for 1961-1965 as it was suggested in EF, table 18. The migration, for both maxima, is summarized as follows:

years:	601–1300	1301–1800	1801–1960	1961–1965
primary:	E11	K02	U21	E13
secondary:	K02 ↑	U21 ↑	E13 ↑	J17-E16

Absolute density, or percentage of total located shocks, is quoted in Table III, which also shows the relative density corresponding to each region (*). The following quadricles show major density:

	absolute	per 10^3 sq. km
C14	3.77	1.5
D12	3.35	1.3
E13	7.12	2.8
E16	4.18	1.7
H15	3.35	1.3
J17	4.18	1.7
J18	3.35	1.3

(*) Relative density is the ratio between absolute density and surface, expressed in percentage of the total area (see EF).

Table III – Seismic active quadricles.

Z	Reg.	Quad	Stock ordinal number (see SD, EF)	A.D. MRD	Energy	⌀
A	1	W06	3501	0.4	0.1 (18)	7.4
		X06	3322–3356	0.8 0.2	0.1 (20)	8.4
				average	*2.02(18)*	
	2	W11	3314	0.4	.	.
		W13	3508	0.4 0.3	.	.
	4a	L16	3373	0.4	0.1 (17)	7.0
		L17	(3347)	0.4	.	.
		S09	3311–3332	0.8	0.1 (20)	8.4
		S15	3324	0.4 1.4	0.1 (19)	8.0
				average	*2.20(18)*	
B	3	T16	3523	0.4	.	.
		U17	3469	0.4 0.4	0.1 (17)	7.0
				average	*2.00(15)*	
	4	U21	3410–3472	0.4 0.3	0.1 (19)	8.0
				average	*2.00(17)*	
	9b	S22	3361–3385	0.8 0.2	0.3 (19)	8.1
				average	*6.00(17)*	
	10	S23	(3414)	0.8	.	.
		T24	3519	0.4	.	.
		T25	3381	0.4	0.1 (20)	8.4
		T26	3355	0.4 0.5	.	
				average	*2.00(19)*	
C	11	J02	3431	0.4	0.1 (18)	7.4
		J03	3408	0.4 0.3	0.1 (18)	7.4
				average	*4.00(16)*	
	12	J09	3544	0.4 0.2	0.1 (18)	7.4
				average	*2.00(16)*	
	13	D01	3487	0.4	.	.
		D02	3325–3370	0.8	0.3 (19)	8.1
		D04	3406–3429	0.8	0.3 (19)	8.1
		H02	3318	0.4 1.1		.
				average	*1.20(18)*	
	14a	D08	(3364)–3354–3391–3310	1.7 (1.1)	0.1 (19)	8.0
				average	*2.00(17)*	
D	14b	E09	3348–3468	0.8 (1.1)	0.2 (18)	7.5
				average	*4.00(16)*	
	15	D10	3320–3473–3534	0.8	0.2 (18)	7.4
		D11	3421–3423–3439–3450 – 3477	2.1	0.2 (17)	7.1
		D12	3399–(3470)–3474–3476 – (3478)–3491–(3513)	3.3	0.8 (18)	7.9
		D13	3308–3337–3359–3475 – 3498	2.5	0.7 (18)	7.8
		D14	3375–3413	0.8	0.8 (16)	6.9
		D15	3372–3417–3485	1.3	0.7 (16)	6.8

(Table III, cont.)

Z	Reg.	Quad.	Shock ordinal number (ree SD, EF)	A.D.	MRD	Energz	Ø
D	15	D16	3351–(3384)–(3386) – 3411–3496	2.1		0.1 (17)	7.0
		D17	3377	0.4		0.1 (19)	8.0
		E11	3340–3363–3422–3481	1.7		0.8 (17)	7.4
		E12	3369–3418–3420–3492	1.7		0.4 (18)	7.8
		E13	3309–3319–3321–3329 – 3352–3353–3354–3358 3374–3378–3428–3430 3432–3445–3459–3520 3416	7.5		0.1 (19)	8.0
		E14	3339–(3367)–3485–3543	1.7		0.4 (18)	7.7
		E15	3382–3400–3482–3514	1.7		0.4 (18)	7.7
		E16	3342–(3380)–3392 – (3403)–3404–3451 – 3461–3479–3500–3526 3464	4.6		0.3 (18)	7.4
		H12	3328	0.4		0.7 (16)	6.8
		H13	3460–3506	0.8		0.3 (17)	7.1
		H14	3512	0.4		0.1 (16)	6.4
		H15	3419–3455–3456–3457 – 3462–3463–3471–3483	3.3		0.1 (20)	8.4
		H16	3401–3458–3486–3502 – 3524	2.5		0.6 (18)	7.8
		H17	3434–3464–3437	1.3		0.7 (16)	7.3
		J11	3516	0.4		0.5 (15)	6.3
		J17	3444–3521–3522–3528 – 3529–3530–3531–3532 3533–3542	4.2	7.5	0.3 (18)	7.6
				average		*3.17(18)*	
	16	E20	3315	0.4		0.3 (17)	7.1
		H18	3316–(3396)–3519	1.3		0.7 (16)	7.1
		H19	3331–3398	0.8		0.7 *(18)*	7.8
		H20	3426	0.4		0.1 (17)	7.0
		J18	3313–3387–3388–3438 – 3440–3442–3443–3452	3.3		0.2 (18)	7.5
		J19	3383–3389–3393	1.3		0.6 (16)	6.8
		K20	3489	0.4		0.1 (18)	7.4
		L18	3539	0.4		0.4 (16)	6.7
		L20	3394–3490	0.8		0.1 (18)	7.4
		L21	3416	0.4	2.2	0.2 (18)	7.5
				average		*2.76(17)*	
	18	A03	3407	0.4		0,5 (19)	8.2
		B02	3350	0.4		0.5 (19)	8.2
		B03	3397	0.4		0.1 (20)	8.4
		B05	3436–3507	0.4		0.1 (22)	9.6
		C04	3326	03.		.	.
		C05	3541	0.4		0.4 (16)	6.7
		C06	3312–3341	0.8	0.8	0.1 (19)	8.0
				average		*4.06(20)*	

(Table III, cont.)

Z	Reg.	Quad.	Shock ordinal number (see SD, EF)	A.D. MRD	Energy	⌀
D	19	A09	3504	0.4	0.3 (17)	7.1
		B10	3454	0.4	.	.
		C07	3371	0.4	0.5 (15)	6.3
		C10	3498–3499	0.8 0.7	0.4 (18)	7.5
				average	*1.10(16)*	
	20	A11	3424	0.4	.	.
		A12	3505	0.4	.	.
		A13	3535–3537	0.8	0.1 (17)	6.8
		A14	3343–3344	0.8	0.7 (18)	7.8
		B11	3395–3447–3515	1.3	0.1 (19)	8.0
		B12	3412–3441	0.8	0.2 (17)	7.1
		B13	3346–3390–3409	1.3	0.2 (19)	8.1
		B14	3335–3402–3405–3433	1.7	0.3 (19)	8.1
		B15	3425	0.4	0.5 (17)	7.3
		C11	3484	0.4	.	.
		C12	3427–3448–3494	1.3	0.1 (18)	7.4
		C13	3336–3357	0.8	0.2 (18)	7.5
		C14	3333–3334–3338–3345 – 3360–3376–3499–3510 3511–3525	4.0	0.5 (18)	7.7
		C15	3322	0.4	0.1 (19)	8.0
		C16	3349	0.4 4.7	0.4 (16)	6.7
				average	*1.70(18)*	
	21a	C17	3449	0.4 (0.7)	0.5 (17)	7.3
				average	*0.10(17)*	
E	21b	A20	3467	0.4	.	.
		B17	3453	0.4	0.4 (18)	7.7
		B21	3480	0.4	0.1 (17)	7.0
		C19	3319–3362	0.8 (07)	0.6 (18)	7.8
				average	*2.02(17)*	
	22	A26	3527	0.4	0.5 (17)	7.3
		A29	3466–3493–3494	1.3	0.1 (20)	8.4
		B30	3536	0.4	.	.
		C23	3327	0.4	0.1 (19)	8.0
		C26	3330	0.4	.	.
		C27	3446	0.4	0.5 (17)	7.3
		C28	3518	0.4	.	.
		D22	3366	0.4	0.2 (18)	7.5
		D23	3368	0.4	0.3 (19)	8.1
		D30	3548	0.4 0.6	.	.
				average	*2.86(18)*	

Z=zone, Reg.=region, A.D.=annual density, MRD=mean regional density, ⌀ =tecnic flux.

SUMMARY:

Zone	energy released		(annual average)	%
A	4.22	(18)	= 4.22 × 10^{18} ergs	1.0
B	4.22	(19)		4.7
C	1.46	(18)		0.3
D	4.11	(20)		93.2
E	3.06	(18)		0.8

annual energy 4.41 × 10^{20} ergs (whole area) 100.0

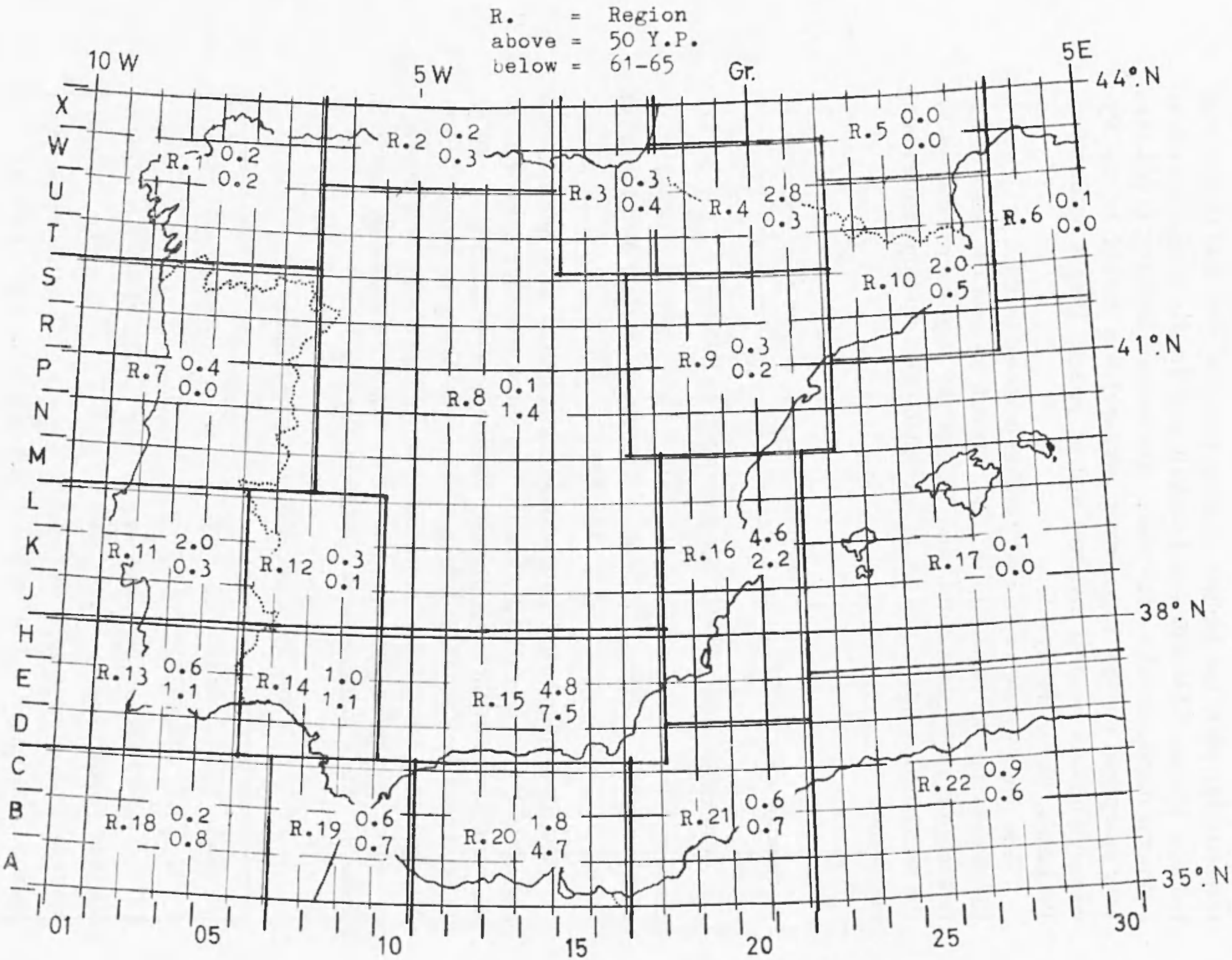

Fig. 1 – Seismic density, 1961-65.

Only E13 was noted as secondary in the 50 YP (values 5.89 and 2.3, respectively) while the highest density was J19, with 8.32 for the said reduced period. This different distribution of density is significative as a general displacement on the area. The seismic activity, in old time very sharpened on the Tagus river (estuary) was moved to the Pyrenees Mountain (central massive) and at present time is on Southern Peninsula, like Easterly.

The relative density for every region is shown in Fig 1, which adds the density for the period up to 1960. It can be seen the positive differences for the regions No. 15 and 20, and the negative differences for the regions No. 11, 4, 10 and 16, in agreement with the comments about migration.

4. Shocks and depth.

Regarding depth, shocks are groupped as follows:

shallow . . . . $h \leqslant 50$ km . . . (isostatic level)
intermediate . . . . . $50 < h \leqslant 413$ km . (Byerly discontinuity)
deep. . . . . $h > 413$ km . . .

The intermediate an the sole deep shocks have been plotted on a sketch of the area as Fig 2 shows. The shock No 3527 is considered doubtful and refused to be plotted, bicause was deduced $h = 160$ by LCSS, h=33 by USCGS and deeper than 113 km processing EPICO. The epicenter for these intermediate shocks agree with the line suggested by means seismicity, drawing the Alpine Geosyncline (see ES). Table IV sum- marizes shocks groupped by depth.

Table IV – Located shocks by depth.

h (km)	kind of shoks	N	%	*m*	5- yard period		level
0 to 5	very shallow	18	7.6	4.2	4.5 (*m*)	2.3(%)	surface
up to 21	shallow (normal h)	198	83.5	»	»	89.4	Conrad
up to 50	remainder sh. sh.	13	5.4	»	»	7.0	isostasy
up to 413	intermediate	8	3.4	4.4 ~ 6.0	4.5 ~ 5.5	1.3	Byerly
414 or more	deep	—	—		(only	one)	

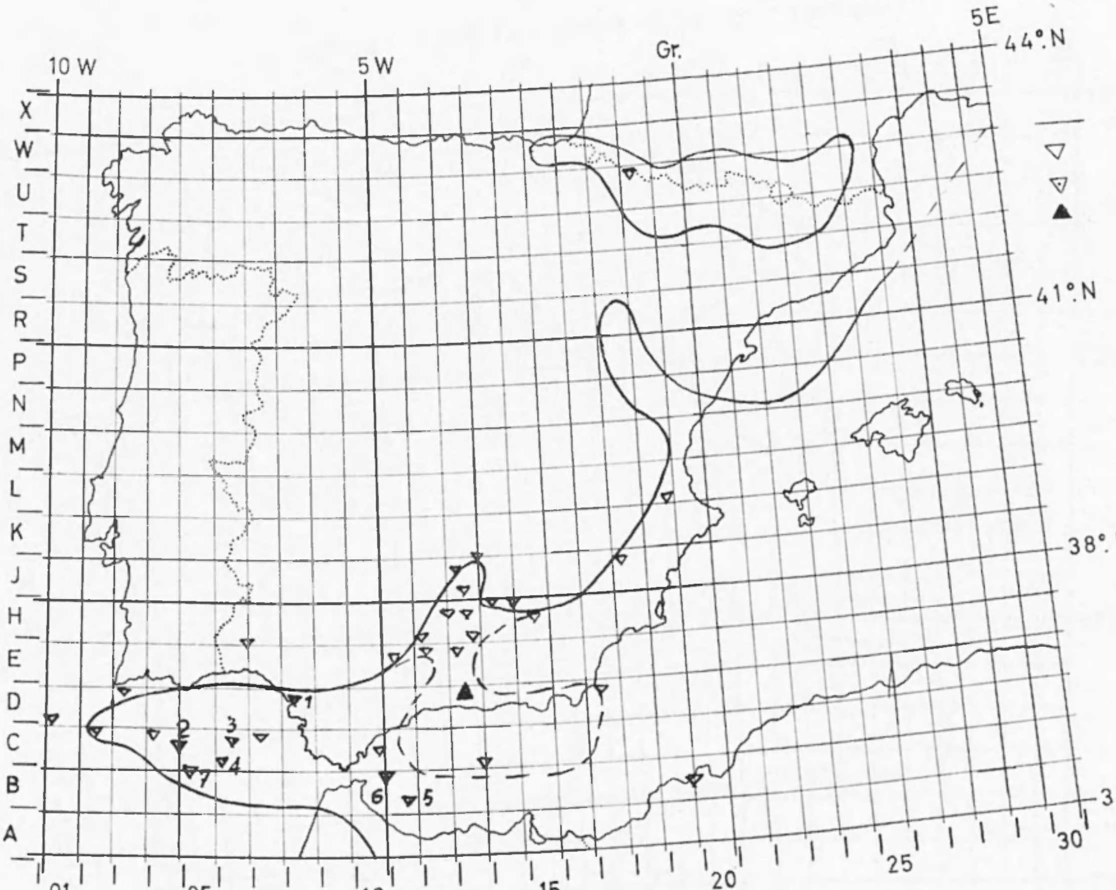

Fig. 2 – Intermediate and deep shocks up to 1965.

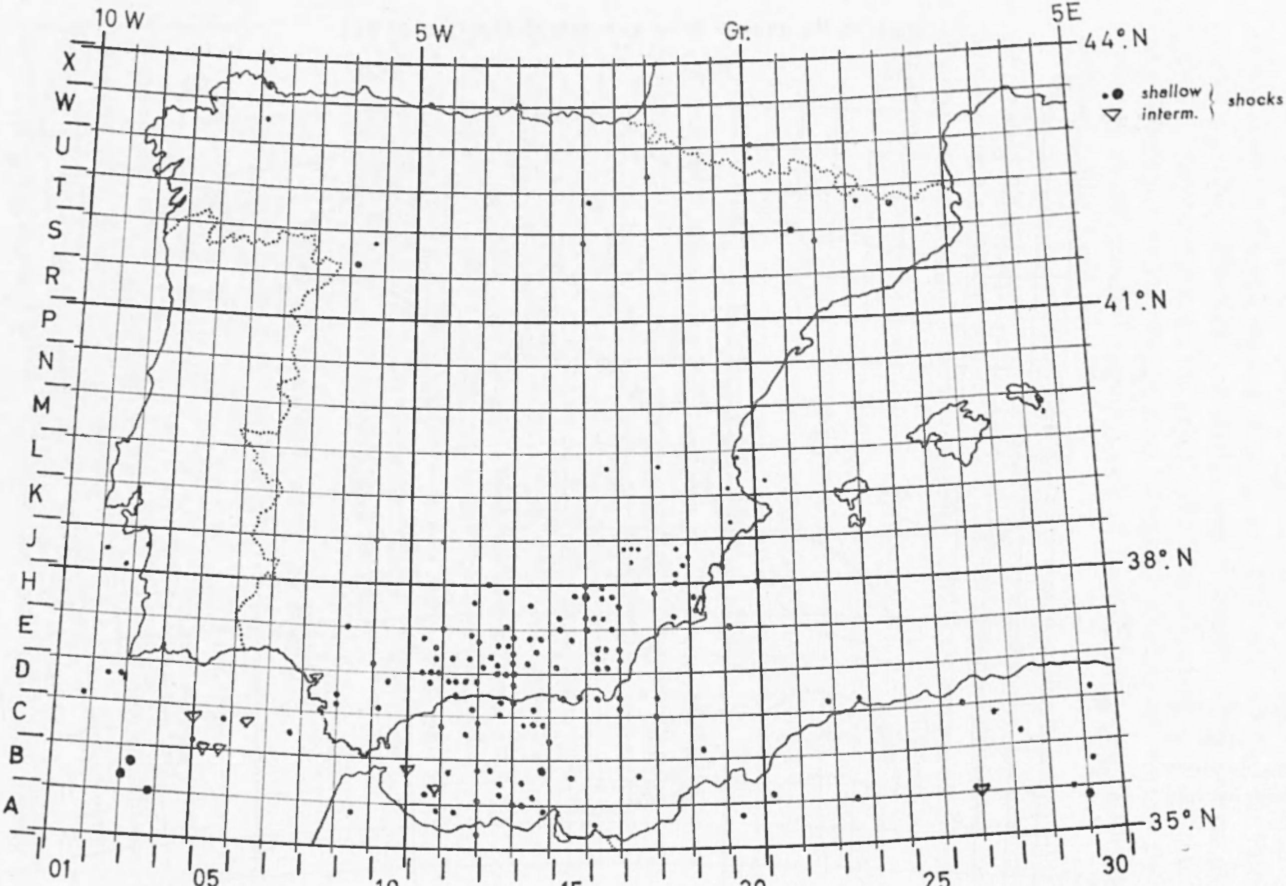

Fig. 3 – Acceptable located earthquakes, 1961-65.

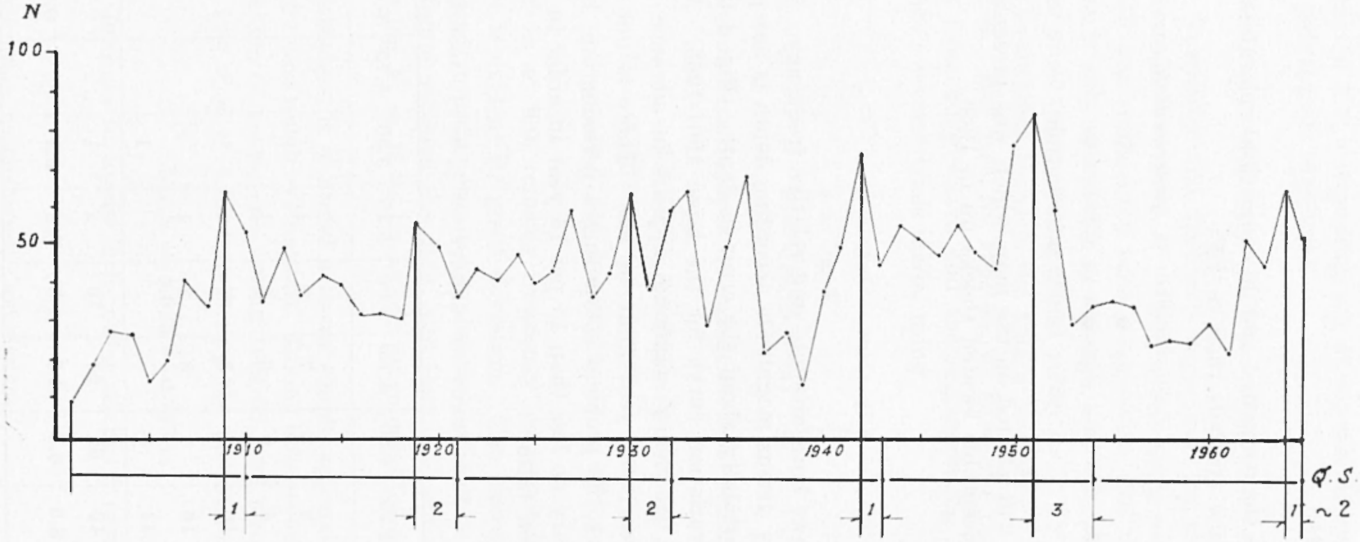

Fig. 4 – Frequency secular variation, 1901-1965.

5. Epicenter map.

Fig. 3 shows the computed and no conjectural epicenters for 1961-65, using the same symbols than in EF:

	shallow	*intermediate*	*deep*
a) $3 \leqslant m < 5$	●	▽	
b) $5 \leqslant m \leqslant 6.5$	●	▽	▲
c) $m > 6.5$	(there is not information)		

These data will plotted on the map which was presented in EF, built with the acceptable located shocks up to 1960.

6. Frequency.

Table V shows both absolute and relative frequency. The comparison frequency versus magnitude according depth is not presented, because the uncertainity about the error in depth. Fig. 4 is the frequency secular variation curve for the lapse 1901-1965. As it was discussed in EF, frequency maximum appears in advance regarding the quiet-solar-year, one year more or less. There is not sufficient material to attack the problem computing a periodogram, because it should be necessary no less than 15 per 13 year in order to deduce a possible correlation ratio.

Table V – Frequency by groups of ¼ *m* (4. to 6.).

year	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	sum
1961	4	2	3	7	5	1				22
1962	6	4	9	6	6	1				32
1963	12	10	7	3	3	1				36
1964	18	16	7	8	2	1			1	53
1965	14	11	8				1			34
absolute	54	43	34	24	16	4	1	.	1	177
relative	10.8	8.6	6.8	4.8	3.2	0.8	0.2	.	0.2	35.4

For the 50 YP, a regression log N, m, was deduced in agreement with the polynomial expression

$$\log N = \sqrt{a\,(8.15 - m)} - b \qquad [2]$$

accepting Gutenberg and Richter's suggestion for the limit $M = 9$ and the formula $m = 0.62\ M + 2.5$, which gives as maximum $m = 8.15$. In EF was commented such a regression, and also that a linear adjustment is only acceptable as a rough approximation and without validity for great values of magnitude. For the 50 YP, the old material was used evaluating through the CSE's formula (*), which relates I and M or m. But here, for 1961-65, we have five years of magnitude computed from body waves and the regression log N, m, neither is linear. After several trials made, using

$$\left.\begin{aligned} y &= Ax^2 + Bx + C \\ y &= \log N \\ x &= \sqrt{(8.15 - m)} \end{aligned}\right\} \qquad [3]$$

the parameters were deduced by means the least square method, and

$$\left.\begin{aligned} A &= -1.42103 \pm 0.261551 \qquad (12\ \%) \\ B &= +8.18902 \pm 0.891998 \qquad (10.9\%) \\ C &= -9.67845 \pm 0.003195 \qquad (\ 0.3\%) \end{aligned}\right\} \qquad [4]$$

for $4.0 \leqslant m \leqslant 6.0$, refusing frequency corresponding to $m = 5.5$ because it is evident its great deviation. The curve has been drawn extrapolating towards $m = 4.5$ and $m = 6.5$ in a dash line. The solution found satisfied the data, and thus it is sufficiently clear that regression log N, m, is no linear but polynomial for our area, as Fig 5 shows.

Nevertheless, it is useful a linear simple approximated regression in order to reach rough evaluations. Taking into account that $m = 4.19$ is the average of magnitude during 1961-65, and also the good agreement for $4.25 \leqslant m \leqslant 4.75$, introducing the parameters in [3] we have

$$\log N = 4.023 - 0.723\ m \qquad [5]$$

available formula to apply it in order to use " expectancy and ex-

(*) European Seismological Commission.

pectant " (*). Since expectancy was defined as the value of m for $N = 10$, using [5], we have

absolute expectancy	$e_a = 4.1812$	for the whole area
mean expectancy	$e_m = 3.0512$	for each 10^4 sq km

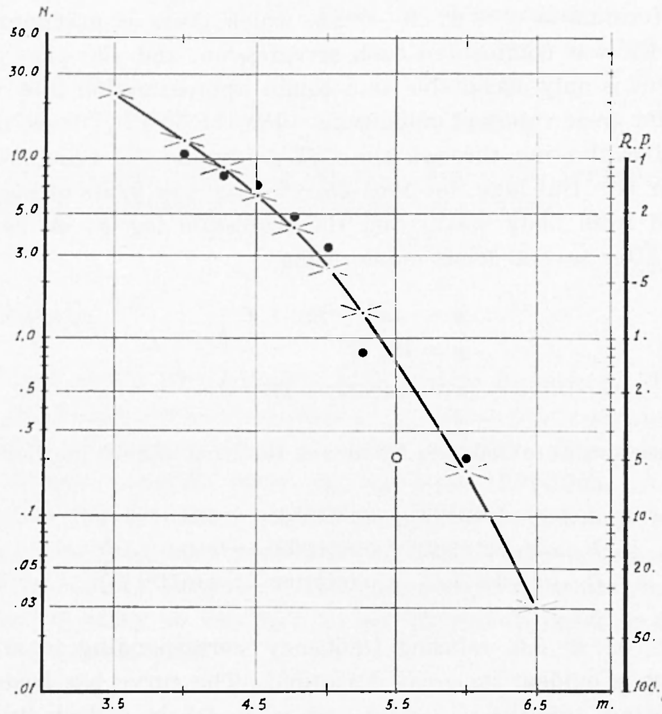

Fig. 5 – Regression log $_{10}$ N versus m, 1961-65.

Comparing these results with those evaluated for the 50 YP ($e_a = 4.852$) it is reasonable to assume that they were higher regarding magnitude, as was discussed in ES, specially respect the most important shocks No. 2881, 2898 and 3052. In other hand, the first adjustment was made establishing steps of 1/2 m, and here m has been groupped in 1/4 m. Consequently, the old information should be displaced about a half unity, less or more, towards the lower m values. Obviously, until we have sufficient material with a well known error for the epicen-

(*) See EF.

ter determination it is not possible to draw the graphs for the convenient two different regressions: both shallow and intermediate shocks.

Table VI shows the mean magnitude for located shocks since 1916 up to 1965, after having corected the corresponding values for the prior 45 years, substracting 1/2 *m*. So, you can see that mean magnitude is almost constant.

Table VI – MEAN VALUES DURING THE LAST 50 YEARS.

Period	Annual energy	Mean magnitude from steps .5*m*	Maximal magnitude from form 171	Located shocks
1916–20	3.20×10^{19}	4.18	5.4	29
1921–25	2.60×10^{20}	4.11	5.7	31
1926–30	2.70×10^{20}	4.28	5.7	39
1931–35	2.03×10^{19}	4.02	5.3	24
1936–40	1.32×10^{19}	4.07	5.2	20
1941–45	2.40×10^{19}	4.11	5.7	42
1946–50	4.15×10^{19}	4.08	5.4	44
1951–55	2.78×10^{23}	4.22	6.8	63
1956–60	5.06×10^{21}	4.35	6.1	64
1961–65	4.41×10^{20}	4.19	5.8	177

7. SEISMIC FLUX.

Following the same criterion and the method which was explained in ES, seismic or tectonic flux has been computed by means the formula

$$\varnothing = \log F = 0.5 \log E_T - 1.097 \qquad [6]$$

where E_T is the total energy released during 1961-65 into each seismically active quadricle (see Table III). Fig. 6 shows these results in order to be able to check them to those presented in ES.

The maximum tectonic flux is just in B05 ($\varnothing = 9.6$) Zone II, Region 18, in Southern area. Energy has been computed using

$$\log E = 4.14 + 28.6\, m\ . \qquad [7]$$

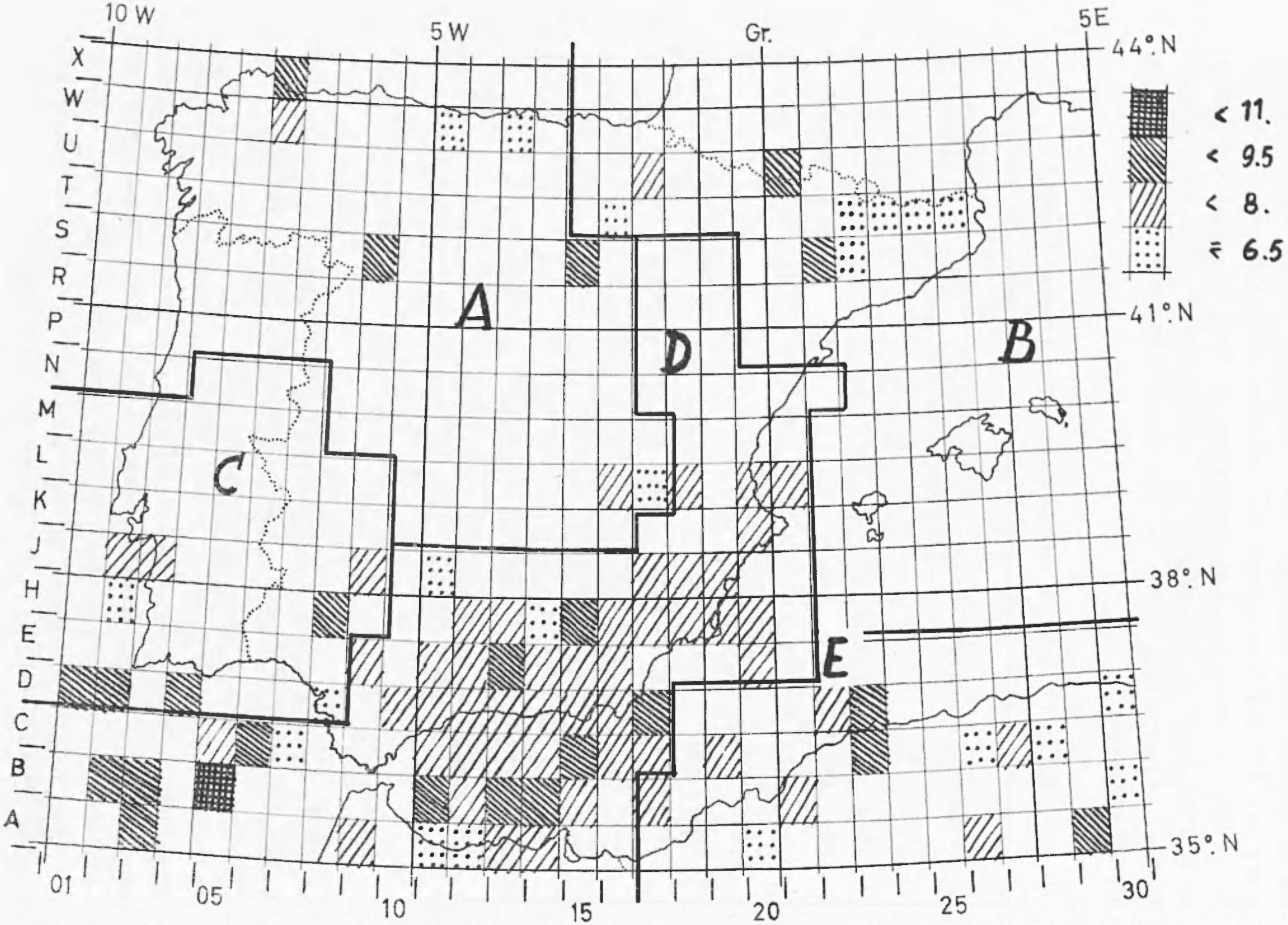

Fig. 6 – Tectonic flux, 1961-65.

Assuming mean magnitude, the error for the energy release evaluation up to 1960 is, more or less, the difference between $\log E = 3.79 + 2.65\, m$ and $\log E = 4.14 + 2.86\, (m - 0.5)$; that is, about 0.11 to add to $\log E$; a value lower than the probable error in magnitude. Thus, it is unnecesary to modify the total amount estimated in ES as the energy released during 160 years, which was 1.5×10^{24} erg, approximately.

Table VI lists also the estimated seismic energy released for the located shocks 1916-65; the annual seismic energy released in 1961-65 is detailed in Table III, for the different zones and regions on the investigated area. Total seismic energy released during the last five years is 2.2×10^{21} erg, approximately, or 4.41×10^{20} erg per year, which represents the 4.7% of the average during the preceding 160 year lapse. In conclussion, the present period, 1961-65, is accumulative, as it was expected from the shape of the Benioff's curve which was drawn in ES.

8. Comments.

The above results, speaking in a general sense, agree with the preliminary ones for the 50 YP. Seismic activity is unquiet on the area, but no mystifying, though its features of frequency and tectonic flux move from year to year. The migration of maximal density is happening since more than one and a half century ago and probably even before. Table VII summarized the main character deduced from the tectonic flux distribution; the intralpine character is emphasized by the ratio I/II (1.96 for the 50 YP and 3.0 for 1961-65). Active quadricles are, respectively, 38,1% for the 50 YP and 18.4% for 1961-65; so we can say that the present period is accumulative. Migration is also confirmed because the particular seismicity of the 50 YP inside the Pyrenees Oval was 17.2% versus total seismicity inside the Alpine Geosyncline, but it is just 4.2% for the lapse 1961-65. Intermediate shocks (preliminary determinations) in 1961-65 agree with the great active faults, in the same way than those shocks up to 1960, (see ES).

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Table VII – CHARACTER OF SEISMICITY FROM THE TECTONIC FLUX DISTRIBUTION ON THE AREA.

	Total Quadricles		Active quadricles (50 year period)			Active quadricles (1961-1965)		
	Nº	%A	Nº	%A	%R	Nº	%A	%R
Alpine:								
a) Pyrenees	22	4.1	20	9.7	3.7	3	3.1	0.6
b) Geosyncl	235	43.5	116	56.3	21.5	71	72.5	13.2
Platform	283	52.4	70	34.0	12.9	24	24.4	4.6
	540	100.0	206	100.0	38.1	98	100.0	18.4
Nº active ones			334		61.9	442		81.6
			540		100.0	540		100.0

SUMMARY IN PERCENTAGE.

	c		d/c	d	
I. Intralpine (*a* + *b*)	66.0	25.2	0.54	75.6	13.8
II. Platform's. . . .	34.0	12.9	0.36	24.4	4.6
	100.0	38.1	0.48	100.0	18.4
Nº active quad.		61.9	1.31		81.6
		100.0			100.0

Remarks:

Nº active quadricles
%A referred to active quadricles
%R referred to total quadricles
a) inside Pyrenees Oval
b) inside W. Mediterranean Alp. Geo.
c) 50 year period
d) 1961-65.
d/*c* comparison ratio

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