Supplements to : In search for the lost truth about the 1922 & 1918 Atacama earthquakes in Chile

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1. Epicenter determinations of the 1922 Atacama earthquake

There were many attempts to locate the epicenter of the 1922 earthquake. Early localization (i.e. before 1950) are essentially based on P waves first arrivals and S-P intervals at different stations. Different authors point out the difficulty to find a common origin for all these data. Some tried to consider the possibility that two different shocks from separate epicenters might have occurred at times so close together that waves from one source would be the first to arrive at stations in one direction while waves from the other source would arrive first at stations in another direction. However, these attempts to locate two distinct epicentres were unsuccessful. More recent determinations are based on re-readings of ancient available seismograms and modern ray tracing and inversion methods. Despite some dispersion, all epicentres fall within a circle of ∼50km radius around the town of Vallenar. Thus, they are all far inland and share a fairly large depth.

source	longitude (°W)	latitude (°S)
Sieberg & Gutenberg, 1924	70.2	28.5
Turner, 1925	71	29
Macelwane & Byerly, 1929	70	29
Mohorovicic, 1939	69.9	28.9
Gutenberg, 1939	70.4	28.4
Gutenberg, 1939	70.3	27.9
Gutenberg & Richter, 1954	70.0	28.5
Engdahl & Villaseñor, 2002	70.755	28.553
ISC	69.85	28.29
ISC-GEM v9.1 Storchak, 2015	70.704	28.988
Kanamori et al. 2019 (ISC-GEM ant.)	70.87	28.91

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2. Coupling models in Atacama

Several coupling models of the Atacama region have been published over the years (Métois et al., 2016; Klein et al., 2018; Molina et al., 2021; Yáñez-Cuadra et al., 2022; González-Vidal et al., 2023). They all slightly differ due to the data used and their inversion methods. In particular, the earlier models are more "patchy" because they use data obtained over a dense network of survey markers, specifically in the Atacama region, without too much smoothing. Other coupling models use only cGPS data and/or combine with survey data from other regions, applying smoothing conditions to homogenize the obtained coupling. However, all of them feature a region of lower coupling at the latitude of Barranquilla (28°S), separating the segments of Atacama in the South (that we believe to be the region of the 1922 earthquake) and Chañaral in the North (that we believe to be the region of the 1918 earthquake).

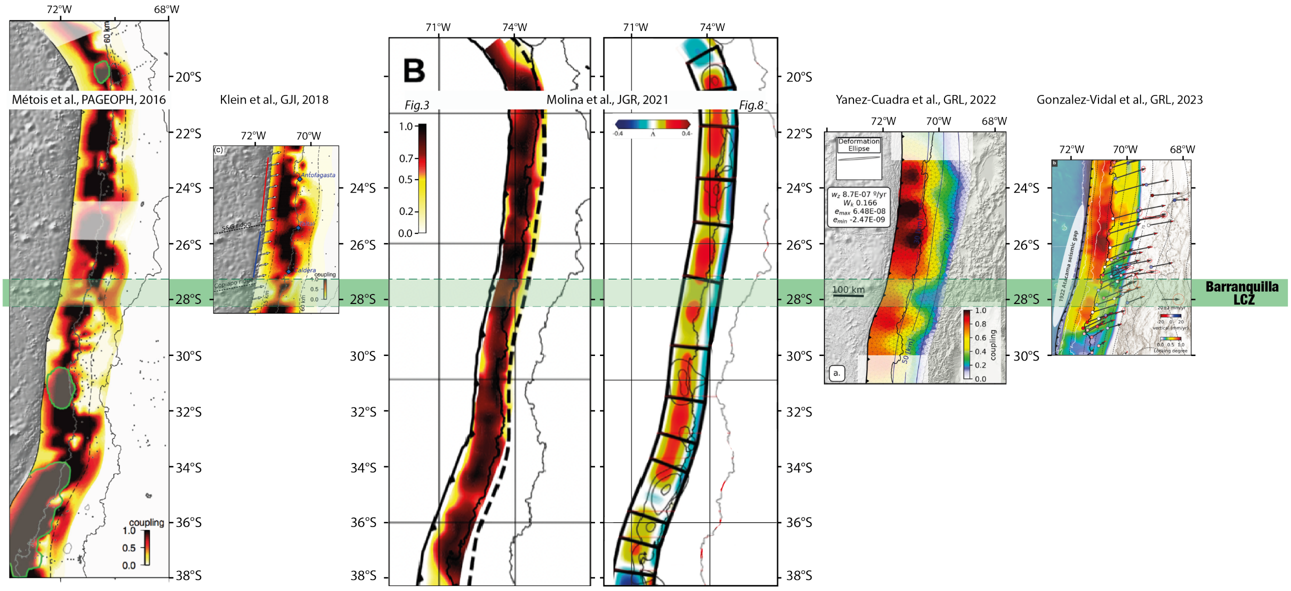

Figure S1: **Comparison of coupling models inferred in Central-North Chile from the present-day geodetic measurements.** From left to right: elastic backslip 3-plates model inferred from survey GPS by (Métois et al., 2016); elastic backslip 3-plates model inferred from survey GPS by (Klein et al., 2018); concatenation of (Moreno et al., 2010, 2012; Tilmann et al., 2016; Li et al., 2015) coupling maps by (Molina et al., 2021, Fig. 3 raw and Fig. 8 after some processing); elastic backslip + regional motion model from GPS by (Yáñez-Cuadra et al., 2022); visco-elastic coupling model inferred from GPS by (González-Vidal et al., 2023). The green line is located at the same latitude and highlights the latitude of the Barranquilla LCZ.

3. Spatio-temporal evolution of 1922 aftershock seismicity according to the International Seismicity Catalog (ISC)

The seismicity catalog that has been used to study the spatio-temporal evolution of aftershocks (main text Fig. 4, Fig. S3, S2) has been extracted from the ISC Bulletin: event catalogue search, Bondár and Storchak (2011) and is provided in a modified form in table 7. The original catalog can be extracted using this link.

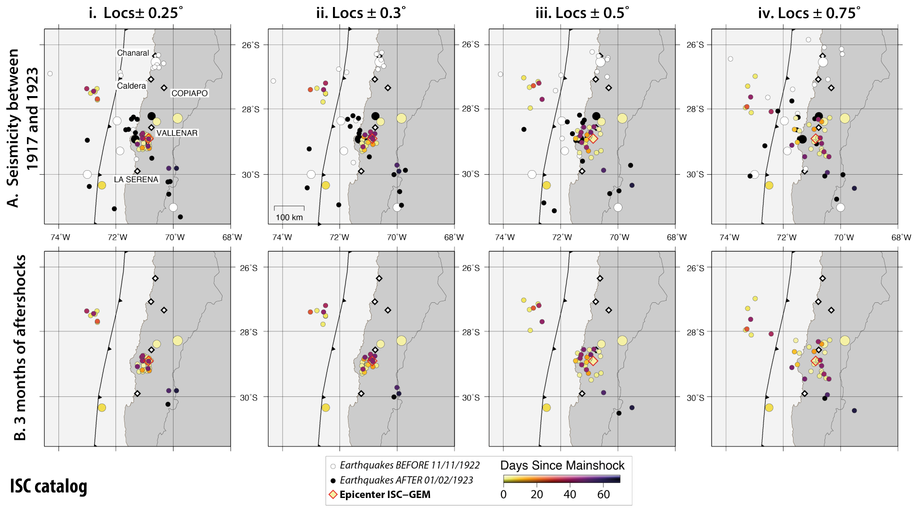

Figure S2: **Spatio-temporal evolution of seismicity around 1922**. International Seismicity Catalog from Bondár and Storchak (2011). Because the precision of localisation is low, we represent the catalog by adding to longitude and latitude a random value of i. ± 0.25°; ii. ± 0.3°; iii. ± 0.5°; iv. ± 0.75°. A. Seismicity between 1917 and 1923, events occurring before the 1922 earthquake are represented in white, events occurring after February 1923 are represented in black; B. Aftershock seismicity over the 3 months following the 1922 earthquake, represented with a color scale as a function of days after the mainshock. For event of Mw $<$ 6.5, no Mw is estimated, we assigned a Mw4 to all of these events for representation purposes. Epicenter from ISC-GEM Bondár et al. (2015).

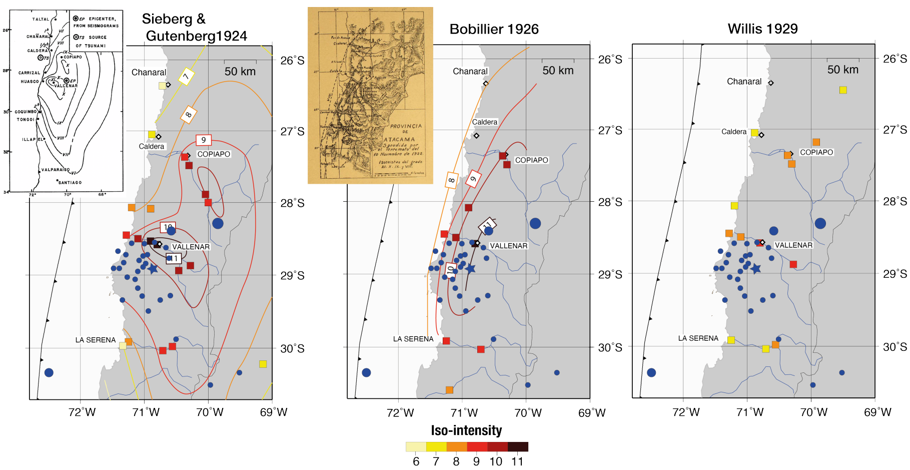

Figure S3: **Comparison of intensities attributed by Sieberg and Gutenberg (1924) (A) ; Bobillier (1926) (B) and Willis (1929) (C)**. The same color scale for intensity is used for figures A B and C, superimposed with the distribution of aftershocks (blue dots, represented with an added random value of ± 0.5°, Fig.S2-B.iii) from ISC catalog Bondár and Storchak (2011). Insets depict the original figures from the corresponding articles.

4. Seismic gap or deficit of seismicity on the flat slab around 30°S

We suggested that the cluster of events occurring near the towns of Vicuña and Rivadavia (30°S,70.75°W), far south and far inland of the 1922 rupture, may not be aftershocks depicting the 1922 rupture fault plane, but rather large independent earthquakes, with their own aftershocks. The suggestion is supported by the occurrence of several (4) additional earthquakes that were detected in this area over seven years bracketing 1922, both before and after 1922, suggesting that an entire multi-year sequence may have been ongoing there, possibly not independent of the 1922 event but not depicting the 1922 rupture plane either. Those earthquakes may be deep events occurring inside the slab that is bend at this latitude because of the transition from the flat slab area south of 30°S."

But, quite interestingly, we don't see them today: this region is quite a seismic gap, at least for the observational period of the last 50 years (Fig. S4). Events of magnitude larger or equal to 5 occur at these depths both north and south of the Vicuña/Rivadavia area, but not in a 100 km long area centered there. So, there is clearly something peculiar about this region that may be related to the double bending of the slab there. However, to understand why and how the stress field related to the bend due to the transition between flat slab and normal deeping slab would produce large deep earthquakes (and possibly a string of associated crustal earthquakes) at given times around large subduction earthquakes (both before and after) and not at other times, is a difficult mechanical problem far beyond the scope of this work.

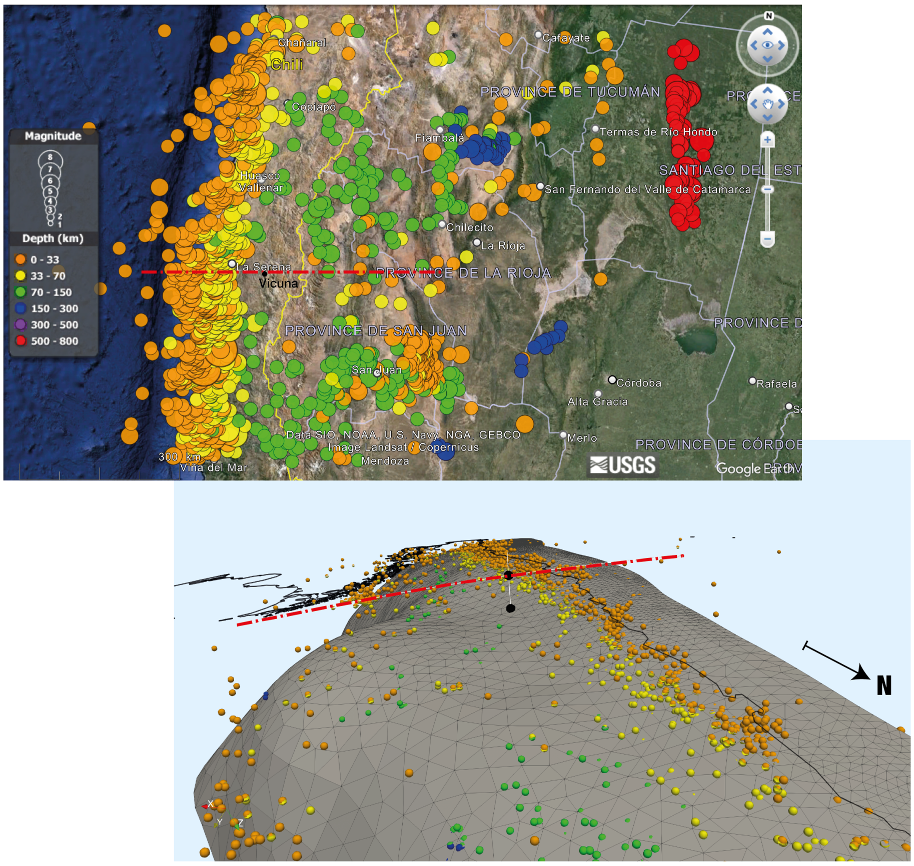

Figure S4: **50-year seismicity (USGS catalog).** Events of Mw > 5 are depicted with color codes according to their depth. On the 3D plot, the triangles depict the slab surface inferred from slab2.0 model (Hayes et al., 2018). The red line depicts the 30°S latitude. The black dots at the surface depict the location of Vicuña/Rivadavia, and the black dot at depth depicts where these coordinates fall on the slab surface.

5. Aftershocks of recent megathrust earthquakes in Chile

In this section, we analyze the surface covered by aftershocks following the two largest megathrust earthquakes that occurred recently in Chile (Maule 2010 Mw 8.8 and Illapel 2015 Mw 8.3). We compare the surface (or the length along the coastline) covered by all aftershocks regardless of their magnitude to the surface (or length) covered by aftershocks of magnitude larger or equal to 6 only. We chose the threshold of Mw = 6 because we think this is the network detection threshold at the time of the 1922 earthquake in the ISC catalog.

Maule 2010 (Mw 8.8) aftershocks over 3 months (Fig. S5-A):

- 1,596 aftershocks of all sizes distributed over a length of $\sim$ 800km
- 24 aftershocks of magnitude larger or equal to 6

Observation: the number of aftershocks larger or equal to 6 does not change significantly after a 3 month duration. There is just 1 or 2 additional large aftershocks of this size after 6 or 9 months.

Therefore:

a) Maule 2010 produced roughly the same number of Mw $\leq$ 6 aftershocks than Atacama 1922: 24 or 25

b) The aftershocks of Mw $\leq$ 6 depict roughly the same surface than all aftershocks

c) The area covered by aftershocks is much larger than the rupture length ($\sim$ 500 km)

Illapel 2015 (Mw 8.3) aftershocks over 3 months (Fig. S5-B):

- 917 aftershocks of all sizes distributed over a length of $\sim$ 400km
- 18 aftershocks of magnitude larger or equal to 6
- The area covered by aftershocks is much larger than the rupture length ($\sim$ 200 km)

Observation: the size of the area depicted by aftershocks is difficult to determine. It largely depends on the selection of which earthquakes are considered aftershocks and which are considered triggered.

Therefore :

a) The number of M $\leq$ 6 aftershocks is slightly smaller for Illapel 2015 than for Maule 2010 or Atacama 1922: 18 (compared to 24 or 25).

b) The aftershocks of Mw $\leq$ 6 depict roughly the same surface than all aftershocks

c) Again, the area covered by aftershocks is significantly larger than the rupture length ($<$ 200 km)

Conclusion: for both Maule 2010 and Illapel 2015, the aftershocks of Mw $\leq$ 6 depict roughly the same surface than all aftershocks. Therefore, it seems reasonable to assume that for an ancient earthquake in this range of magnitude and for which only aftershocks of magnitude larger or equal to 6 were detected, the surface these large aftershocks depict is similar to the surface that was actually covered by all aftershocks. In all cases, the earthquake rupture length is significantly smaller than the length of the surface covered by aftershocks. Note that the number of aftershocks of magnitude larger or equal to 6 is of the same order of magnitude for Illapel 2015 (18), Maule 2010 (24) and Atacama 1922 (25). However, these numbers are sensitive to the chosen threshold: Illapel 2015 has 23 aftershocks of magnitude larger or equal to 5.9 and Maule 2010 has 31. So, it is not possible to estimate a comparative magnitude for Atacama 1922 with respect to Illapel 2015 and Maule 2010 magnitudes through the number of large aftershocks following these earthquakes.

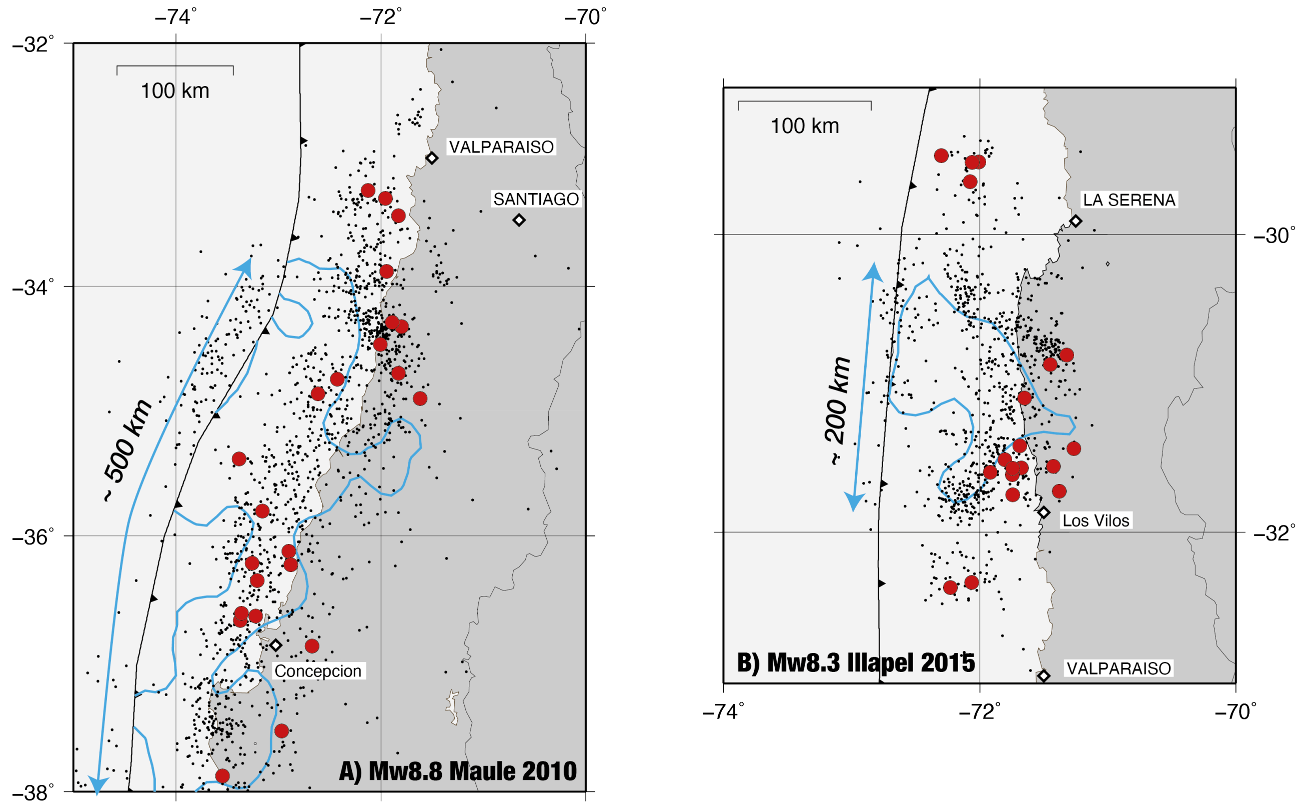

Figure S5: **Slip distribution and aftershocks of recent major megathrust earthquakes in Chile**. A) the 2010 Mw8.8 Maule earthquake and B) the 2015 Mw8.3 Illapel earthquake. Black dots depict all events occurring during a 3-month time period after the main shocks. Large red dots depict those of magnitude larger than 6. Blue lines depict the slip distributions of the 2010 Maule earthquake from Klein et al. (2016)(left) and the 2015 Illapel earthquake from Klein et al. (2017) (right)

6. 1922 distribution of intensities by L. Sierra-Vera

Note by B. Willis : *It being impossible to interview personally any considerable number of individuals in the different towns or throughout the province, a questionnaire was prepared, with the aid of Dr. Sierra, and was officially distributed by the Governor of the Province of Atacama, Dr. Luis Romero. About a thousand were sent out and some three hundred were returned. The information which they contain varies greatly in character, and the labor of digesting the answers to the questions was considerable. Dr. Sierra undertook the labor of analyzing the responses to the questionnaires, and evaluate the intensities at different points. To this task Dr. Sierra brought special experience and knowledge of his countrymen. His digest of the data and his estimates of intensity, expressed in terms of the Rossi-Forel scale, are given in the following tables. In the following notes, the data contained in a number of the questionnaires are arranged for the convenience of the reader, somewhat in narrative form, but with strict adherence to the facts as stated by the individual contributors.*

We reproduced the corresponding table, with slights modifications to enhance readability in table 7).

7. Rossi-Forel and Mercali modified intensity scales

The following description of intensity scales and their correspondance is a reproduction of Davis (1982), Appendix: Rossi-Forel Scale, Modified Mercalli Scale, and Richter Scale

ROSSI-FOREL INTENSITY SCALE

The first scale to reflect earthquake Intensities was developed in the 1880s by de Rossi of Italy and Forel of Switzerland. This scale, with values from 1 to 10, was used for about two decades. The most commonly used form of the Rossi-Forel (R-F) scale reads as follows:

1. Microseismic shock. Recorded by a single seismograph or by seismographs of the same model, but not by several seismographs of different kinds; the shock felt by an experienced observer.
2. Extremely feeble shock. Recorded by several seismographs of different kinds; felt by a small number of persons at rest.
3. Very feeble shock. Felt by several persons at rest; strong enough for the direction or duration to be appreciable.
4. Feeble shock. Felt by persons in motion; disturbance of movable objects, doors, windows, cracking of ceilings.
5. Shock of moderate intensity. Felt generally by everyone; disturbance of furniture, beds, etc., ringing of some bells.
6. Fairly strong shock. General awakening of those asleep; general ringing of bells; oscillation of chandeliers; stopping of clocks; visible agitation of trees and shrubs; some startled persons leaving their dwellings.
7. Strong shock. Overthrow of movable objects; fall of plaster; ringing of church bells; general panic, without damage to buildings.
8. Very strong shock. Fall of chimneys; cracks in the walls of buildings.
9. Extremely strong shock. Partial or total destruction of some buildings.
10. Shock of extreme intensity. Great disaster; ruins; disturbance of the strata, fissures in the ground, rock falls from mountains.

MODIFIED MERCALLI INTENSITY SCALE

A need for a more refined scale increased with the advancement of the science of seismology, and in 1902, the Italian seismologist Mercalli, devised a new scale on a I to XII range. The Mercalli scale was modified in 1931 by American seismologists Harry O. Wood and Frank Neumann to take into account modern structural features. The Modified Mercalli (MM) scale reads as follows:

I Not felt except by a very few under especially favorable circumstances.

II Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.

III Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly, Vibration like passing of truck. Duration estimated.

IV During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned, Disturbances of trees, poles and other tall objects sometimes noticed. Pendulum clocks may stop.

VI Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII Everybody runs outdoors. Damage negligible in building of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.

VIII Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.

IX Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great In substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent, Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.

The Modified Mercalli Intensity scale measures the intensity of an earthquake's effects in a given locality, and is perhaps much more meaningful to the layman because it is based on actual observations of earthquake effects at specific places. It should be noted that because the data used for assigning Intensities can be obtained only from direct firsthand reports, considerable time - weeks or months - is sometimes needed before an intensity map can be assembled for a particular earthquake. On the Modified Mercalli intensity scale, values range from I to XII. The most commonly used adaption covers the range of intensity from the conditions of "I–not felt except by very few, favorably situated," to "XII–damage total, lines of sight disturbed, objects thrown into the air." While an earthquake has only one magnitude, it can have many intensities, which decrease with distance from the epicenter.

CORRELATION OF MODIFIED MERCALLI AND ROSSI-FOREL SEISMIC INTENSITY SCALES

To convert from R-F to MM, the following table may be useful:

Rossi-Forel	1	3	5	7.75	8.75	9.5	10
Mercalli modified	I	III	IV-V	VI	VIII	IX	X-XII

Table S1: Seismicity catalog from International Seismicity Catalog, Bondár and Storchak (2011), between 01/01/1917 and 31/12/1924. Events have been ordered and counted geographically, as represented on Fig.4 in the main text.

ID	catalog	dd-mm-yy	NbDays since MS	hh:mm:ss.ss	Lat	Lon	Mw *if est.*	**Nb Events**
913410	GUTE	15-02-17	-2095	00:48:24	-30	-73	-	**1**
913580	GUTE	27-07-17	-1933	02:51:48	-31	-70	-	**1**
913147	ISC	20-05-18	-1636	17:55:07.21	-29.2923	-71.8574	6.8	**1**
913362	ISC	04-12-18	-1438	11:47:50.43	-26.5376	-70.6076	7.9	**1**
913363	ISS	04-12-18	-1438	17:41:40	-26.5	-70.5	-	
913364	ISS	06-12-18	-1436	07:21:52	-26.5	-70.5	-	
913366	ISS	06-12-18	-1436	11:27:40	-26.5	-70.5	-	
913368	ISS	07-12-18	-1435	12:39:35	-26.5	-70.5	-	
913371	ISS	09-12-18	-1433	10:58:30	-26.5	-70.5	-	
913375	ISS	13-12-18	-1429	01:18:40	-26.5	-70.5	-	**6**
912703	ISS	05-01-19	-1406	19:51:40	-29.6	-71.5	-	**1**
912729	ISS	20-02-19	-1360	12:32:55	-27	-72	-	**1**
912653	ISS	28-10-20	-744	12:50:06	-27	-74.4	-	**1**
912350	ISS	25-10-21	-382	00:47:30	-27	-72	-	**1**
911964	ISS	28-07-22	-106	08:00:00	-28.5	-71.5	-	**1**
912079	ISS	15-11-22	4	06:43:20	-27.5	-72.8	-	
912080	ISS	15-11-22	4	06:54:30	-27.5	-72.8	-	
912081	ISS	15-11-22	4	08:16:20	-27.5	-72.8	-	
912082	ISS	16-11-22	5	04:45:00	-27.5	-72.8	-	
912108	ISS	08-12-22	27	15:07:44	-27.5	-72.8	-	
912119	ISS	19-12-22	38	03:00:30	-27.5	-72.8	-	
912122	ISS	23-12-22	42	17:22:24	-27.5	-72.8	-	**7**
911382	ISS	27-05-23	197	16:21:36	-28.5	-71.5	-	
911457	ISS	20-07-23	251	04:46:48	-28.5	-71.5	-	
911463	ISS	22-07-23	253	00:16:04	-28.5	-71.5	-	
911467	ISS	24-07-23	255	03:32:50	-28.5	-71.5	-	
911488	ISS	07-08-23	269	07:27:50	-28.5	-71.5	-	
911232	ISS	18-12-24	768	15:24:40	-28.5	-71.5	-	**6**
912057	ISC	07-11-22	-4	23:00:17.63	-28.365	-71.9603	7.0	**1**
912062	ISC	11-11-22	0	04:32:51.44	-28.2926	-69.852	8.3	**1**
912063	ISC	11-11-22	0	18:09:31.24	-28.3893	-70.58	6.5	**1**
912083	ISC	17-11-22	6	11:02:53.78	-30.3327	-72.4891	6.6	**1**
912064	ISS	11-11-22	0	20:45:40	-29	-71	-	
912065	ISS	11-11-22	0	21:41:00	-29	-71	-	
912067	ISS	11-11-22	0	22:19:30	-29	-71	-	
912068	ISS	11-11-22	0	23:26:00	-29	-71	-	
912069	ISS	12-11-22	1	07:09:00	-29	-71	-	
912070	ISS	12-11-22	1	15:21:29	-29	-71	-	
912071	ISS	12-11-22	1	17:50:30	-29	-71	-	
912072	ISS	12-11-22	1	21:53:30	-29	-71	-	
912074	ISS	13-11-22	2	04:01:45	-29	-71	-	
912075	ISS	13-11-22	2	04:13:00	-29	-71	-	
912076	ISS	13-11-22	2	04:35:00	-29	-71	-	
912077	ISS	13-11-22	2	07:08:45	-29	-71	-	
912078	ISS	13-11-22	2	08:51:00	-29	-71	-	
912089	ISS	20-11-22	9	21:13:40	-29	-71	-	
912090	ISS	21-11-22	10	03:46:08	-29	-71	-	
912092	ISS	26-11-22	15	13:30:00	-29	-71	-	
912093	ISS	26-11-22	15	14:05:45	-29	-71	-	
912120	ISS	22-12-22	41	21:07:13	-29	-71	-	
912121	ISS	23-12-22	42	09:11:40	-29	-71	-	
912125	ISS	24-12-22	43	18:44:12	-29	-71	-	
912126	ISS	24-12-22	43	18:46:25	-29	-71	-	
912129	ISS	25-12-22	44	19:40:20	-29	-71	-	
912130	ISS	27-12-22	46	00:37:26	-29	-71	-	
912132	ISS	28-12-22	47	12:40:42	-29	-71	-	**25**
911248	ISS	03-01-23	53	09:41:28	-30	-70	-	
911254	ISS	12-01-23	62	01:54:28	-30	-70	-	
911257	ISS	20-01-23	70	21:36:27	-30	-70	-	**3**
911275	ISS	04-02-23	85	15:46:48	-31	-72	-	**1**
911297	ISS	25-02-23	106	02:24:42	-29.5	-71	-	**1**
911307	ISS	09-03-23	118	22:56:12	-29	-71	-	**1**
911335	ISS	21-04-23	161	17:12:40	-30.5	-70	-	**1**
911338	ISS	24-04-23	164	14:03:12	-31.2	-69.6	-	**1**
911356	ISC	04-05-23	174	22:26:50.85	-28.9284	-71.3324	7.0	**1**
911390	ISS	01-06-23	202	15:31:25	-30	-70	-	**1**
911441	ISS	10-07-23	241	00:28:54	-30.5	-73	-	**1**
911479	ISS	31-07-23	262	16:33:26	-29	-73	-	**1**
910820	ISC	29-01-24	444	01:54:58.92	-28.2221	-70.7551	6.7	**1**

Table S2: 1922 intensities modified after Willis (1929) Appendix II. Compilation by Luis Sierra-Vera in 1923. Conversion from Rossi-Forel scale (R-F) to Mercalli modified (MM) scale performed using Davis (1982) formula (see main text and Sup. section 5)

Place	Name	Eq.Time	Ground	House	Damage	Furniture overturned	Intensity	
							R-F	MM
El Salado	Carlos Jorquera D.	11h55m	alluvion	Wood with corrugated iron roof		Sideboard, cabinets, etc.		
Chañaral	Raphael Basaure C.		slag heap	Wood with galvanized iron	none	Nothing fell		
	Guillermo Zepeda	11h30m	solid	Wood with roof of corrugated iron	none	None		
	Maria Toro de Zevallos		beach sand	Wood with corrugated iron	none	None		
	Oswald Fernie		sand	Wood frame with zinc	none	Nothing fell		
Potrerillos	Luis S. Rojas A.		solid	Adobe, wood and zinc	insignificant	Nothing fell	8	7.5
	Hermojenes Pizzaro	11h50m	limey beds	Corrugated iron	none	do.	7	6.5
	Enrique Vicuna	11h55m	solid	Adobe and wood frame	slight	pictures, etc	8	7.5
	Manuel Ossandon	11h50m	alluvion	Adobe	only cracks	nothing	8	7.5
	Jose Figueroa	11h55m	solid	Canvas	none	Nothing fell	7	6.5
	Valentin Pena	11h50m	wash	Adobe	slight	nothing	8	7.5
	Jorje Vallejos Gallo	11h50m	solid	Adobe and wood	slight	do.	8	7.5
Caldera	Francisco Linandarija	11h50m	solid	Wood	none	Nothing fell	7	6.5
	Enrique Escobar	11h45m	do	With cane and roof of zinc	none	do.	7	6.5
	Jorge Lado Bercera	11h50m		Cane with mud and zinc	none	none	7	6.5
	Bernardo Tornini	11h50m	rocky	do.	none	Nothing fell	7	6.5
	Guillermo W. Lara	11h55m	silt	Wood cane and mud	none	none	7	6.5
	Ana S. de Baez	11h48m	solid rock	Wood with roof of zinc	none	Nothing fell	7	6.5
	Jose Rubio	11h53m	clayey	Tapiales and adobes	appreciable	do.	8	7.5
	Santiago H. Faull	11h45m	solid	Adobes cane and wood	slight	do.	8	7.5
Puquios	Arturo A. Cabrera	11h55m	alluvion	Wood frame adobe and wood	appreciable	Nothing fell	8	7.5
	Jacinto Herrera A.	11h55m	do.	Wood frame	do.	tables, wardrobes, etc.	8	7.5
	A. Mahuecin Robledo	11h55m	do.	adobe and wood	considerable	tables, cabinets, etc.	9	8.5
Copiapo	Carlos A. Gonzales	11h55m	alluvion	Framework with Guayaquil cane	uninhabitable	Sideboards and small table	10	9.5
	Francisco E Yuraszeck G.		do.	Pine wood	partial destruction	nothing	9	8.5
	Ramon Albornoz	11h48m	do.	Tapiales, adobes, wood, and guayaquil cane	destroyed	everything	10	9.5
	Luis A. Romo Ch.	11h55m	firm	Wood with guayaquil cane	heavy damage	various furniture	9	8.5
	Federico Melendez M		do	Wood frame	small	nothing	9	8.5
	Juan de D. Picon	11h50m	alluvion	Tapiales and adobes	moderate damage	a bureau	9	8.5
	Alfredo R. Ansieta	11h50m	do	Walls and wood frame	heavy damage	various furniture	9	8.5
	Manuel F. Munizaga	11h50m	do	Adobes and adobes with wood	do.	cabinets and statuary	9	8.5
	Manuel Corona F.	11h50m	do	Wood with guayaquil cane	moderate damage	some	9	8.5
	Ernesto Berg. Floto	11h50m		Tapiales, adobes and wood frame	heavy damage	wardrobe and iron safe	9	8.5
	Ernesto Pareda L.	11h55m	very alluvial	Tapiales, adobes and wood frame	do.	one table	9	8.5
	Manuel Castillo Z.	11h50m		Frame with brush	uninhabitable	wardrobes and cabinets	10	9.5
	Jorje Laferriere	11h50m	alluvial	Adobes and Tapiales	do.	some	10	9.5
	Crisologo Cispedes	11h45m	sedimentary	Wood frame with guayaquil cane	heavy damage	much	9	8.5
	Jorje Barquin V.	11h45m	alluvion	walls and wood frame	roof destroyed & base of walls	some	9	8.5
	Domingo Riveros T.		do	Tapiales and adobes	total destruction	destroyed	10	9.5
	Ramon Rosas A.			Tapiales	heavy damage	nothing	9	8.5
	Luis Gmo. Brand	11h46m	firm	Wood frame	appreciable		8	7.5
	Jose Escauriaza		alluvion	Wood frame	do.	cabinets and shelves	8	7.5
	Ladislas Agullo	11h50m	do	do.	heavy damage	part of clothes press.	9	8.5
	Margarita De pellegrini		do	do.	appreciable	all the furniture	8	7.5
	Alberto Vallejos C.	11h50m	firm ground	do.	moderate	wardrobes	8	7.5
	Roberto Meeks V.		soft	do.	considerable	many fell, others not.	9	8.5
	Felix Piuciro O.	11h50m	wash	Wood frame boards and some adobe	do.	everything fell	9	8.5
	Horacio Arce B	11h55m	alluvion	Wood frame with zinc roof	appreciable	a cabinet	8	7.5
	Julio A. Bravo	11h50m	do	Wood frame, boards and mud	do.		8	7.5
	Vincente Rogers C.	11h48m	do	Wood frame	do.	some, such as bookcases	8	7.5
	Aristides G. Garcia	11h47m	near hill	Adobes, wood, and corrugated iron	moderate	did not fall, but moved toward west	8	7.5
	Fabriciano Morales	11h55m		Wood frame	insignificant	a cabinet	8	7.5
	Oscar Letelier	11h55m	sediment	Adobes, cane, and wood	moderate	wardrobes and shelves	8	7.5
	Lidia Richards	11h55m		Mud	insignificant	nothing fell	8	7.5
	Pedro Villagran	11h50m	alluvion	Adobes and corrugated iron	appreciable	cabinets small tables wardrobes etc.	8	7.5
	Samuel Jenkins	11h50m	do	Wood and cane	slight	wardrobes	8	7.5
	Francisco Finus	11h55m		Adobes and wood frame	appreciable	cupboards and tables	8	7.5
	Anjel E. Guerra O	11h53m	wash	Tapiales and cane	considerable	wardrobes and cabinets	9	8.5
	Guillermo Barth C	11h45m	alluvion	Adobes and wood frame	appreciable	wardrobes and cabinets	8	7.5
	Ricardo A. Vallejos	11h55m	do	Wood frame	do.	bureaus and wardrobes	8	7.5
	J. Amadio Beluzan	11h55m		Cane and mud	moderate	heavy wardrobes	8	7.5
	Amalia Julio De Amor		on solid hill	Adobes and cane	considerable	many articles of furniture	9	8.5
	Manuel meneses R	11h50m	alluvion	Adobes wih wood	moderate	one round table with three legs	8	7.5

Table S2: (continued from previous page)

Tierra Amarilla	Lorenzo Jofre Flore	11h55m	alluvion	Cane with wood and mud	considerable	wardrobes and ohers	9	8.5
	Jose Felix Zamorano	11h54m	do.	Wood, brush and roof of zinc	appreciable	shelves etc	8	7.5
	Juan 2nd Echeverria	11h55m	firm	Wood frame	moderate	a wardrobe	8	7.5
	Pedro Cerda	11h45m	alluvion	Wood frame with cane	do.	some fell	8	7.5
	Carmelo Destefani	11h45m	firm	Wood with cane	do.	buffets, tables, etc.	8	7.5
	Eduardo Thaden	11h55m	alluvion	Cane and mud	appreciable	wardrobes, cabinets, etc.	8	7.5
	Martin Vitali	11h45m	rock and alluvion	Cane, mud and wood	considerable	tables, chairs, etc.	9	8.5
Carrizal Bajo	Pedro Cuello	11h50m	firm rock	Wood, mud and corrugated iron	slight	tables, wardrobe, etc.	8	7.5
	Vincente Arredondo		firm	Wood	none	bookcases with books.	7	6.5
	Fernando A. Zadivich	11h56m	solid rock	Wood and corrugated iron				
	Carlos A. 2nd Echegaray	11h56m	rocky	Wood	none	nothing fell	7	6.5
	Juan A. Contreras		solid rock	Wood	none		7	6.5
	Tomas C. Tello	11h55m	solid	Wood with mud	none in building	none	7	6.5
Huasco	Luis Hurtado V.	11h55m		Adobes with wood and zinc	considerable	all the furniture	9	8.5
	J. Manuel Villanueva	11h50m	alluvion	tiles and adobes with zinc roof	uninhabitable	nothing fell	10	9.5
	Clodomiro Marticorona	11h55m	solid	Wood frame and zinc	slight	nothing	8	7.5
	Pedro Cruz	11h50m	solid	Wood and zinc	none	some boxes	7	6.5
	Antonio Montero	11h55m	solid	Wood frame and zinc	considerable	wardrobes, cabinets, tables, etc	9	8.5
	Francisco Quinones	11h55m	solid	do.	sight		8	7.5
	Pedro 2nd Ruiz	11h50m	alluvion	Wood frame with adobes and mud	uninhabitable	wardrobes, sideboards, tables, etc	10	9.5
Freirina	L. Vega A.		solid	Brush and mud	insignificant	nothing fell	8	7.5
	Braulio Blanco Torres		gravel	Wood frame and corrugated iron	moderate	cabinets, etc.	8	7.5
	Felix M. Amengual	11h58m	solid	Tapiales and adobes	considerable	nothing fell	9	8.5
	Luis A. Roman	11h54m	do.	Adobes wood and zinc	moderate	cabinets, tables, etc.	8	7.5
Vallenar	Silvano Vargas M.	11h40m	alluvion	Adobe with woven brush	uninhabitable	wardrobe, sideboard and shelves	10	9.5
	Eduardo Wolf	11h45m	of gravel	Wood frame with small adobes	moderate	contents of shelves	8	7.5
	Ivan Franulie	11h50m	alluvion	Adobe with boards and corrugated iron	heavy damage	mostly pictures	9	8.5
	Alejandro Flores	11h55m	do.	Tapiales , adobe and zinc roof	very great	tables, boxes, stands, etc.	9	8.5
	Zacarias Rocas, G.	11h55m	do.	Adobe, wood and corrugated iron	considerable	various articles of furniture	9	8.5
	Custodio Cruz		Coarse stream wash	Tapiales and adobes	uninhabitable	everything fell	10	9.5
	Arsenio Tapia, O.		alluvion	Adobe and wood	do.	pictures and racks	10	9.5
	Manuel Varela, D.	11h50m	do.	Tapiales wood and mud	uninhabitable	wardrobe	10	9.5
	Ceferino Tornero		firm	Adobe, wood and zinc	moderate	all furniture	8	7.5
	Francisco Cantuarias	11h57m	alluvion	Tapiales, adobe and wood	considerable		9	8.5
	Pascual Soler	11h50m	do.	Tapiales and adobes	heavy damage	everything buried	9	8.5
	Ricardo Adriazola	11h54m	Coarse stream wash	Walls adobe and wood frame	considerable	wardrobes and washstands	9	8.5
	Hernando Osandon	11h54m	Made ground	Wood frame with galvanised iron	small	the furniture did not fall	8	7.5
	Guillermo Gray, L.	12h0m	alluvion	Tapiales, adobe and wood	very appreciable	wardrobes, stands, etc.	9	8.5
	Luis de Block	11h55m	Bed of old river	Adobe walls and zinc roof	walls shook much; roof did not	almost everything	9	8.5
	Leoncio Bardian	11h46m	alluvion	Adobe wall, wood frame and wood	uninhabitable	furniture was crushed	10	9.5
	Delfina P. v. de Femenias	11h55m		Adobe & Wood frame, roof of boards & zinc	do.	much was demolished	10	9.5
	Erminia C. de Diaz		alluvion	Wood, zinc, corrugated iron and tapiales	do.	all the furniture	10	9.5
	Elba J. Pinto			Tapiales with thatched roof	do.	do.	10	9.5
	Augustin Barraza	11h55m		Wood frame, adobe	only in walls	sideboard	8	7.5
	Ester Flores de Mery		alluvion	Tapiales and adobes with zinc roof	uninhabitable	nothing fell over	10	9.5
	Pantaleon Barraza		Sandy	Adobe and wood	considerable	do.	9	8.5
	Francisco Diaz	11h55m	alluvion	Tapiales and wood	uninhabitable	everything fell	10	9.5
	Hector Mieres, A.	11h49m	Firm	Adobe, wood frame and zinc	do.	tables, chairs, etc.	10	9.5
	Jose M. Caballero			Adobe walls, Adobes and wood	moderate	wardrobes, pictures, etc.	10	9.5
	Rosa, Juleta, J.			Adobes, wood frame and wood	appreciable	furniture did not fall	10	9.5
	Transito v. de Ordenes	11h50m		Mud walls and adobes	uninhabitable	everything fell	10	9.5
	Abdon Naini	11h55m	Sandy	Adobes and mud walls	do.	do.	10	9.5
	Abraham Q. Rodriguez		alluvion	Adobes	considerable	do.	9	8.5
	Hernando Mancilla		alluvion	Tapiales and adobes	uninhabitable		10	9.5
	Carlos Aguilar	11h50m	Earth	Tapiales, adobes and zinc	do.	bookshelves, bureaus, etc.	10	9.5
	Luis A. Hidalgo	11h55m	alluvion	Tapiales and thatch	do.	everything fell	10	9.5
	Max Nolff	11h50m	do.	Tapiales with zinc roof	do.		10	9.5
	Juan A. Pereira	11h50m		Adobes and wood frame	moderate	much fell	8	7.5
	Guillermo Gallo	11h50m	Sedimentary	Adobes and wood	considerable	wardrobes, bookshelves, etc.	9	8.5
	Victor Arochas	11h40m	alluvion	Wood frame and adobes	do.	all the furniture	9	8.5
	Hector Miranda			Tapiales and adobes	do.	nothing fell from movement	9	8.5
	Pablo A. Morales	11h55m		Adobes, wood frame and zinc	uninhabitable	everything fell	10	9.5
	Maximo Reygadas	12h0m	alluvion	Adobes, tapiales and corrugated iron	considerable	nothing fell	9	8.5
	Ventura Galan	11h45m		Tapiales, adobes, wood and corrugated iron	uninhabitable	everything fell	10	9.5
La Serena	Gustavo Lagos	11h50m	solid, rocky	Adobe and wood	insignificant	nothing fell	8	7.5
	Jose M Zarate	11h47m	rocky	Adobes and zinc roof	moderate	a mirror	8	7.5
	Blanc D. de Lazo	11h50m	firm	Adobes and wooden roof	nothing	nothing	7	6.5

Table S2: (continued from previous page)

	Josias Richards C.	11h50m	firm	Adobes and wood frame	moderate	a goblet from the table	8	7.5
	Pedro Godoi L.	12h15m	firm	Wood frame, adobes and zinc roof	appreciable	some pictures	8	7.5
	Maria E. Araya	12h10m	solid	Adobes and wood	do.	some small tables	8	7.5
	Oscar Miranda G.	11h55m	solid	Tapiales, wood and corrugated iron	none	mostly tables	7	6.5
	Antolin Anguita B.	12h0m	firm	Adobes and zinc roof	moderate	objects from shelves	8	7.5
	Federico Kuhlmann	11h55m	firm	Tapiales, wood frame and galvanized iron	appreciable	pedestal with vase	8	7.5
	Eulojio Robles R.	11h50m	solid	Wood and zinc	insignificant	nothing fell	8	7.5
	Alfredo Claussens	11h52m				do.		
	Luis F. Alfaro V.	11h55m		Tapiales, adobes and wood frame	insignificant	some furniture	8	7.5
	Maria L. Pinto	11h56m	solid	Adobes with zinc	none	no furniture fell	7	6.5
	Luis R. Barraza	11h47m	rocky	Adobes, wood and zinc	slight		8	7.5
	Oscar Cabezas B.	11h55m	solid	Adobes	insignificant	nothing fell	8	7.5
	Emilio de la Torre	11h50m	solid	Adobes and wood	moderate	do.	8	7.5
	Hugo Bravo R.	11h55m	alluvion	Adobes and wood	heavy damage	all the furniture	9	8.5
	Julio Mantero	11h55m	firm	Adobes, wood frame and zinc	insignificant	nothing fell	8	7.5
	Rosa Cortez A.	11h55m	solid	Wood frame and adobes	none	do.	7	6.5
	Bernardo Cortiz D.	11h50m	firm	Adobes, wood, and zinc	slight	tables, pictures, etc	8	7.5
	Eduardo Olivares C.	11h57m	solid	Light material	do.	wardrobes, sideboards, tables, etc.	8	7.5

References

Bobillier, C. (1926). Boletín del Servicio Sismológico de Chile - XVI - Año de 1922 - terremoto de Atacama. *Talleres de El Diario Ilustrado, Santiago de Chile.*

Bondár, I., Engdahl, E. R., Villaseñor, A., Harris, J., and Storchak, D. (2015). ISC-GEM: Global Instrumental Earthquake Catalogue (1900–2009), II. Location and seismicity patterns. *Physics of the Earth and Planetary Interiors*, 239:2–13.

Bondár, I. and Storchak, D. (2011). Improved location procedures at the International Seismological Centre: Improved location procedures at the ISC. *Geophysical Journal International*, 186(3):1220–1244.

Davis, J. F. (1982). Earthquake planning scenario : For a magnitude 8.3 earthquake on the San Andreas fault in Southern California. California Department of Conservation, Division of Mines and Geology, Special Publication n°61(Special Publication n° 61).

González-Vidal, D., Moreno, M., Sippl, C., Baez, J. C., Ortega-Culaciati, F., Lange, D., Tilmann, F., Socquet, A., Bolte, J., Hormazabal, J., et al. (2023). Relation between oceanic plate structure, patterns of interplate locking and microseismicity in the 1922 atacama seismic gap. *Geophysical Research Letters*, 50(15):e2023GL103565.

Hayes, G. P., Moore, G. L., Portner, D. E., Hearne, M., Flamme, H., Furtney, M., and Smoczyk, G. M. (2018). Slab2, a comprehensive subduction zone geometry model. *Science*, 362(6410):58–61.

Klein, E., Fleitout, L., Vigny, C., and Garaud, J. (2016). Afterslip and viscoelastic relaxation model inferred from the large-scale post-seismic deformation following the 2010 Mw 8.8 maule earthquake (chile). *Geophysical Journal International*, 205(3):1455–1472.

Klein, E., Métois, M., Meneses, G., Vigny, C., and Delorme, A. (2018). Bridging the gap between North and Central Chile: insight from new GPS data on coupling complexities and the Andean sliver motion. *Geophysical Journal International*, 213(3):1924–1933.

Klein, E., Vigny, C., Fleitout, L., Grandin, R., Jolivet, R., Rivera, E., and Métois, M. (2017). A comprehensive analysis of the Illapel 2015 Mw8.3 earthquake from GPS and InSAR data. *Earth and Planetary Science Letters*, 469:123–134.

Li, S., Moreno, M., Bedford, J., Rosenau, M., and Oncken, O. (2015). Revisiting viscoelastic effects on interseismic deformation and locking degree: A case study of the Peru-North Chile subduction zone. *Journal of Geophysical Research: Solid Earth*, 120(6):4522–4538.

Molina, D., Tassara, A., Abarca, R., Melnick, D., and Madella, A. (2021). Frictional segmentation of the chilean megathrust from a multivariate analysis of geophysical, geological, and geodetic data. *Journal of Geophysical Research: Solid Earth*, 126(6):e2020JB020647.

Moreno, M., Melnick, D., Rosenau, M., Baez, J., Klotz, J., Oncken, O., Tassara, A., Chen, J., Bataille, K., Bevis, M., et al. (2012). Toward understanding tectonic control on the mw 8.8 2010 maule chile earthquake. *Earth and Planetary Science Letters*, 321:152–165.

Moreno, M., Rosenau, M., and Oncken, O. (2010). 2010 maule earthquake slip correlates with pre-seismic locking of andean subduction zone. *Nature*, 467(7312):198–202.

Métois, M., Vigny, C., and Socquet, A. (2016). Interseismic Coupling, Megathrust Earthquakes and Seismic Swarms Along the Chilean Subduction Zone (38°–18°S). *Pure and Applied Geophysics*, 173(5):1431–1449.

Sieberg, A. and Gutenberg, B. (1924). Das Erdbeben in der chilenischen Provinz Atacama am 10. November 1922. *Veroffentlichungen der Reichsanstalt fur Erdbebenforschung in Jena*, 137.

Tilmann, F., Zhang, Y., Moreno, M., Saul, J., Eckelmann, F., Palo, M., Deng, Z., Babeyko, A., Chen, K., Báez, J. C., et al. (2016). The 2015 illapel earthquake, central chile: A type case for a characteristic earthquake? *Geophysical Research Letters*, 43(2):574–583.

Willis, B. (1929). Earthquake conditions in Chile. *Publication of the Carnegie Institution of Washington*, 382.

Yáñez-Cuadra, V., Ortega-Culaciati, F., Moreno, M., Tassara, A., Krumm-Nualart, N., Ruiz, J., Maksymowicz, A., Manea, M., Manea, V. C., Geng, J., and Benavente, R. (2022). Interplate Coupling and Seismic Potential in the Atacama Seismic Gap (Chile): Dismissing a rigid Andean Sliver. *Geophysical Research Letters*, 49(11).