

9/56 YEAR CYCLE: RECORD EARTHQUAKES

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Abstract: The biggest earthquakes ever recorded in Hawaii and south western North America tended to occur within a 9/56 year grid (McMinn, 2011). Given such an unusual finding, it was hypothesized that record quakes in other regions would also exhibit a 9/56 year effect. Various catalogues on historical earthquakes in the Americas, Western Europe and Japan were assessed for such an outcome. Surprisingly, record seismic episodes often fell within the same sector of the complete 9/56 grid, most notably in Sequences 25, 34, 43, 52 and 05. Sequence 52 was by far the most important 56 year sequence, as it contained so many US and Western European records. Why these patterns are apparent for record earthquakes remains very puzzling and unexpected. It probably has something to do with Moon-Sun tidal triggering as proposed by McMinn (2011), but that is all that can be stated. Seasonality was also pertinent in some of the findings, suggesting that the Sun's ecliptical position may have relevance in earthquake timing.

Key words: record, earthquake, 9/56 year, cycle, USA, Western Europe, Japan

Introduction

Record quakes in south western North America and Hawaii tended to cluster within a 9/56 year pattern (McMinn, 2011). The obvious question emerged as to whether record quakes in other regions would also group in a 9/56 year grid or was this something unique to California and Hawaii. This paper considers the 9/56 year cycle and the timing of record seismic episodes in the Americas, Western Europe and Japan. Surprisingly, these records often occurred in one sector of the complete 9/56 year grid around Sequences 25, 34, 43, 52 and 05. This was a common theme in the findings derived from this appraisal.

The timing and estimated magnitudes of historic quakes become more unreliable the further one goes back in time. Additionally, the estimated magnitudes can vary considerably according to reference source, which may give a range of records for a particular country or region. These problems made it difficult to assess the early raw data properly, especially for Latin America. Ideally, the catalogues should be both comprehensive and accurate, but this was often not the case. Unfortunately, little could be done to counter these difficulties, apart from using reputable reference sources. Even then, distortions may easily arise in some samples.

The 9/56 year cycle consists of a grid repeating the interval 56 years vertically and 9 years horizontally. The 56 year columns have been called sequences and the 9 year horizontal rows sub-cycles. The 56 year sequences have been numbered in accordance with McMinn (1993), with 1817, 1873, 1929, 1985 being designated Sequence 01; 1818, 1874, 1930, 1986 as Sequence 02 and so forth. McMinn (Appendix 2, 2002) presented the full numbering. Dates in some of the tables have been expressed as YYYYMMDD. The National Geophysical Data Center has been abbreviated to NGDC, as has the US Geological Survey to USGS. These were two of the main references used in the paper.

Records in South Western North America

McMinn (2011) established a 9/56 year cycle in the timing of record earthquakes in south western North America. Crucially, the three 56 year sequences in **Table 1** (Sqs 34, 43 & 52) experienced many record events.

- * Sq 34 - Record northern Californian quake (San Francisco. April 18, 1906. M8.25).
- * Sq 34 - Record New Mexico quakes happened in 1906 on July 16 and November 15 (both M5.8).
- * Sq 34 - Equal 1st rank Arizona quake (Flagstaff. Jan 25, 1906. M6.2).
- * Sq 43 - Record quake for Nevada (Pleasant Valley. Oct 3, 1915. M7.7).
- * Sq 43 - 20th century record quake for Baja California (Nov 21, 1915. M7.1).
- * Sq 52 - Record quake for western USA (Great Cascadia. Jan 26, 1700. M9.0).
- * Sq 52 - Record quake for Hawaii (Apr 2, 1868. M7.9).

* Sq 52 - Record US volcanic eruption (ex Alaska) (Mt St Helens, May 18, 1980).

The notable exception was the biggest seismic event in southern California (Fort Tejon. Jan 9, 1857. M7.9).

Table 1 9/56 YEAR CYCLE: RECORDS IN SOUTH WESTERN NORTH AMERICA Year beginning January 1				
Sq 34		Sq 43		Sq 52
				1700 Jan 26
1738	+ 9	1747	+ 9	1756
1794	+ 9	1803	+ 9	1812
1850	+ 9	1859	+ 9	1868 Apr 02
1906 Jan 25 (a) Apr 18 Jul 16 Nov 15	+ 9	1915 Oct 03 Nov 21 (b)	+ 9	1924
1962	+ 9	1971	+ 9	1980 May 18

(a) The [Arizona Earthquake Information Center](#) gave two record Arizona quakes of M6.2 - on January 25, 1906 and August 18, 1912.
 (b) This was the record quake for Baja California until the recent April 4, 2010 quake (M7.2).
 Years in **bold** contained record events in Hawaii and south western North America.

Record quakes by US State

The USGS presented a listing of the record quake for each of the 50 US states (see **Appendix 1**), of which 19 occurred in the 12 months commencing April 1 of those years in **Table 2** (significant p < .01). (NB: California, Illinois, Nebraska, New Hampshire and Oregon were each listed as having two record quakes of about equal intensity, all of which were included in the appraisal.) In **Table 2**, the greatest significance appeared in five 56 year sequences (Sqs 34, 43, 52, 05 & 14), which experienced 12 state record quakes (significant p < .01).

Table 2 9/56 YEAR CYCLE: RECORD QUAKES BY US STATE Year beginning April 1										
Sq 34	Sq 43	Sq 52	Sq 05	Sq 14	Sq 23	Sq 32	Sq 41	Sq 50	Sq 03	Sq 12
								1754	1763	1772
		1756	1765	1774	1783 1130	1792	1801	1810	1819	1828
1794	1803	1812	1821	1830	1839	1848	1857	1866	1875	1884
1850	1859	1868 0403	1877 1115	1886 0901	1895	1904	1913 1914 0305	1922	1931 0816 1217	1940 1220 1224
1906 0418 1115	1915 1003 1916 0221	1924	1933 1934 0312	1942	1951	1960	1969 1120	1978	1987	1996

1962 0410	1971	1980 0727	1989 1990 0113	1998 0925	2007					
<p>Years in bold contained US record earthquakes in the year beginning April 1 of those years in the table. Source of Raw Data: USGS. <i>The Largest Earthquakes, State by State.</i> http://neic.usgs.gov/neis/states/state_largest.html</p>										

Record quakes by North American region

The record quakes by North American region were sourced from the USGS and the Geological Survey of Canada (see **Appendix 2**) (NB: Two earthquakes of about equal magnitude were given for California - Nevada.). Of the 13 records for US - Canadian regions, 6 occurred in Sequences 34, 43, 52, 05 & 14 (see **Appendix 3**), whereas about 1.2 could have been anticipated. Most of these 13 records may also be presented in 18/56 year and 36/56 year grids shown in **Tables 3 & 4** respectively. Strangely, all four records by Canadian region occurred in **Table 4**.

According to the USGS, the record Mexican quake for the 20th century took place on June 3, 1932 (M8.2), which did not fall in either **Tables 3 or 4**. However, the second rank episode (Sep 19, 1985. M8.1) appeared in Sequence 01 and in **Table 4**.

Table 3 18/56 YEAR CYCLE: RECORD QUAKES BY NORTH AMERICAN REGION 12.5 months ending September 1						
Sq 34		Sq 52		Sq 14		Sq 32
		1756 1755 Nov 18	+ 18	1774	+ 18	1792
1794	+ 18	1812 Feb 16	+ 18	1830	+ 18	1848
1850	+ 18	1868 Apr 03	+ 18	1886 Sep 01	+ 18	1904
1906 Apr 18	+ 18	1924	+ 18	1942	+ 18	1960 1959 Aug 18
1962	+ 18	1980	+ 18	1998	+ 18	2016
<p>Record quakes by US region have been presented in bold. Source of Raw Data: USGS, Canadian Geological Survey.</p>						

Table 4 36/56 YEAR CYCLE: RECORD QUAKES BY NORTH AMERICAN REGION Year ending November 20								
Sq 05		Sq 41		Sq 21		Sq 01		Sq 37
				1781	+ 36	1817	+ 36	1853
1765	+ 36	1801	+ 36	1837	+ 36	1873 1872 Dec 15	+ 36	1909 May 15
1821	+ 36	1857 Jan 09	+ 36	1893	+ 36	1929 Nov 18	+ 36	1965
1877	+ 36	1913	+ 36	1949 Aug 22	+ 36	1985		

1933 Nov 20	+ 36	1969	+ 36	2005					
1989	+ 36	2025							
Record quakes by US and Canadian regions have been presented in bold . Source of Raw Data: USGS, The Geological Survey of Canada.									

Record Western European Quakes

The 9/56 year layout in **Table 2** for US state records was also assessed in relation to Western European quakes (see **Table 5**). Record events for major countries in Western Europe were sourced from the USGS and the NGDC (see **Appendix 4**).

The 9/56 year grid in **Table 5** contained several Western European records since 1900.

- * Equal 1st rank record Greek quake (Aug 11, 1903. M8.3).
- * 1st and 2nd rank Italian quakes (Calabria. Sep 8, 1905. M7.9; Avezzano. Jan 13, 1915. M7.5).
- * Two equal 1st rank record Turkish quakes (Dec 26, 1939. M7.8; Aug 9, 1912. M7.8).
- * Record UK quake (North Sea. Jun 7, 1931. M6.1.).
- * Record quake for Portugal - Morocco (Feb 28, 1969. M7.8).
- * Record quake for the Azores Islands (Jan 1, 1980. M7.8).
- * Record quake for the North Atlantic (Nov 25, 1941. M8.3).
- * 2nd rank German quake (Mar 14, 1951. M5.8)

Importantly, the Great Lisbon Quake fell in Sequence 52 and was the record seismic event for Western Europe since 1700 (Lisbon. Nov 1, 1755. M9.0).

Table 5 9/56 YEAR CYCLE: RECORD WN EUROPEAN QUAKES 1900 - 2011 Year ending June 15										
Sq 34	Sq 43	Sq 52	Sq 05	Sq 14	Sq 23	Sq 32	Sq 41	Sq 50	Sq 03	Sq 12
						1904 1903 0811	1913 1912 0809	1922	1931 0607	1940 1939 1226
1906 1905 0908	1915	1924	1933	1942 1941 1125	1951	1960	1969 0228	1978	1987	1996
1962	1971	1980 0101	1989	1998	2007					
Years in bold contained record quakes appearing in the year ending June 15. Main Source of Raw Data: USGS.										

Record Sequence 52

Sequence 52 was the most notable of all the 56 year sequences, as it experienced many records in the USA and Western Europe (see **Table 6**) some of which were among the most famous seismic events in history. In 1700, 1756 and 1812, the earthquakes all took place in the four months to February 28. The Mount St Helens eruption happened on May 18, 1980 and was the biggest US volcanic event to take place in the contiguous 48 states.

The 19th century record quakes for South America (Arica. Aug 13, 1868. M9.0) and Puerto Rico (Nov 18, 1867. M7.5) showed up in this sequence, as did the record event for Venezuela (Caracas. Mar 26, 1812. M7.7). The 20th century record for Algeria (El Asnam. Oct 10, 1980. M7.3) also occurred in Sequence 52.

Table 6			
RECORD US & WESTERN EUROPEAN QUAKES IN SEQUENCE 52			
Year ending August 15			
Sequence 52	M	Event	Record
Jan 26, 1700	9.0	Great Cascadia	Record for North America (ex Alaska)
Nov 01, 1755	9.0	Great Lisbon quake	Record for Western Europe
Nov 18, 1755	6.3	Boston quake	Record quake in north east USA
Feb 18, 1756	6.3	Duren quake	Record German quake
Feb 12, 1812	7.9	New Madrid quake	Record quake in central USA
Apr 03, 1868	7.9	Hawaii	Record Hawaiian quake
Aug 13, 1868	9.0	Great Arica quake	19 th century record for South America
Sep 01, 1923	8.4	Tokyo quake	The deadliest Japanese quake
Jan 01, 1980	7.3	Azores quake	20 th century record for the Azores Islands
May 18, 1980	na	Mt St Helens eruption	Record US eruption (ex Alaska)
Source: McMin, 2006			

Record Japanese Earthquakes

A listing of major Japanese earthquakes since 1890 was sourced from the NGDC (see **Appendix 5**). Of the top 10 Japanese earthquakes ($M \Rightarrow 8.3$), five appeared in **Table 7** comprising only five 56 year sequences. These five episodes all happened in the 3.3 months to March 5 and compared with an expected frequency of about 0.3. The record quake for Japan (March 11, 2011. M9.0) did not fall in this 9/56 year pattern. Of the three equal 2nd rank Japanese quakes (M8.7) since 1890, one took place in Sequence 43 and in this table (Nov 24, 1914. M8.7). Kazuya Fujita listed the 20th century record Japanese quake as occurring on March 2, 1933 (Sq 05, M8.6) and the 3rd rank quake on September 1, 1923 (Sq 52, M8.3), both of which fell in **Table 7** (6.2 months ending March 5).

Table 7 9/56 YEAR CYCLE:				
MAJOR JAPANESE QUAKES 1890 - 2011 (M => 8.3)				
3.3 months ending March 5				
Sq 25	Sq 34	Sq 43	Sq 52	Sq 05
1897	1906	1915	1924	1933
Feb 07	Jan 21	1914		Mar 02
Feb 19		Nov 24		
1953	1962	1971	1980	1989
2009				
Major Japanese quakes ($M \Rightarrow 8.3$) appearing in the 3.3 months ending March 5 are presented in bold .				
Source of Raw Data: NDGC. Search parameters: Japan. 1890 to 2010. M: 8.3 to 9.5.				

A notable 9 year sub-cycle was clearly evident, with all 6 events occurring in the half year ending March 2 (see **Table 8**).

Table 8 9 YEAR SUB-CYCLE & JAPANESE QUAKES			
Half year ending March 2			
9 YSC	Date	Location	M
1897	Feb 07, 1897	Japan	8.3
	Feb 17, 1897	Japan	8.3
+ 9			
1906	Jan 21, 1906	South coast Honshu	8.4
+ 9			
1915	Nov 24, 1914	Volcano Islands	8.7
+ 9			
1924	Sep 01, 1923	Tokyo	7.9 (a)

+ 9			
1933	Mar 02, 1933	East coast Honshu	8.4
+ 9			
1942	Nov 18, 1941	Shikoku	7.9
(a) Fujita listed this estimated magnitude at 8.3.			
Source: NGDC. Search parameters: Japan. 1890 to 2010. M8.3 to M9.5.			

Record Latin American Quakes

A listing of record earthquakes (post 1900) for Latin American countries was compiled from the NGDC (see **Appendix 6**). The following records happened within an 18/56 year grid as presented in **Table 9**.

- * Equal 1st rank Colombian earthquake (Jan 20, 1904. M7.9).
- * Record Central American quake (Dec 20, 1904. M8.3).
- * Two equal 1st rank Ecuadorian quakes (Sep 29, 1906. M7.9 & May 14, 1942, M7.9).
- * Equal 1st rank Caribbean quake (Dec 2, 1906. M7.9).
- * Equal 1st rank quake in Argentina (Jan 15, 1944. M7.8).
- * Record Chilean quake (May 22, 1960. M9.5).
- * 2nd rank Peruvian quake (Aug 24, 1942. M8.2).

The 18/56 year configuration in **Table 9** could only be produced using NGDC data, as the other historic listings failed to yield such patterning.

Unfortunately, reference sources listing Latin American quakes varied considerably in the given magnitudes and thus record events (see **Appendix 6**). According to Fujita, “*Pre-1900 South American events listed in some catalogs appear to have overestimated magnitudes*” and were thus omitted from his compilations. The unreliability of the early data created an assessment problem and no conclusions can be drawn on record quakes for Latin America.

Table 9 18/56 YEAR CYCLE:								
RECORD LATIN AMERICAN QUAKES 1900 - 2011								
Year beginning January 1								
Sq 16		Sq 34		Sq 52		Sq 14		Sq 32
								1904 Jan 20 Dec 20
		1906 Jan 31 Dec 02	+ 18	1924	+ 18	1942 May 14	+ 18	1960 May 22
1944 Jan 15	+ 18	1962	+ 18	1980	+ 18	1998	+ 18	2016
2000								
Record Latin American earthquakes denoted in bold happened in the year beginning January 1.								
Source of Raw Data: NGDC. Search parameters: Relevant country. 1900 to 2010. M8.2 to M9.5.								

Major World Quakes

Kazuya Fujita of the Michigan State University presented a catalog of the biggest earthquakes ($M \Rightarrow 8.2$) occurring around the world from 1900 to 2010 (see **Appendix 7**). The Japanese quake of March 11, 2011 was inserted into this compilation. A total 50 events post 1900 were listed by Fujita, of which 19 happened in October 31 ended years in **Table 10** (significant $p < .05$). Much higher significance could be achieved

with the inclusion of the pre 1900 events also listed by Fujita. Of a total 73 major earthquakes since 1700, 31 showed up in this table (significant $p < .001$).

Table 10 9/56 YEAR CYCLE: FUJITA WORLD QUAKES SINCE 1700 Year ending October 31												
Sq 25	Sq 34	Sq 43	Sq 52	Sq 05	Sq 14	Sq 23	Sq 32	Sq 41	Sq 50	Sq 03	Sq 12	Sq 21
										1707	1716	1725
			1700	1709	1718	1727	1736	1745	1754	1763	1772	1781
1719	1728	1737	1756	1765	1774	1783	1792	1801	1810	1819	1828	1837
			1755				0822			0616		
			1101									
1785	1794	1803	1812	1821	1830	1839	1848	1857	1866	1875	1884	1893
1841	1850	1859	1868	1877	1886	1895	1904	1913	1922	1931	1940	1949
0517			0813	0510							0524	0822
1897	1906	1915	1924	1933	1942	1951	1960	1969	1978	1987	1996	2005
0612	0131		0414	0302		1950	0522	0811			0218	0328
0921	0817		0626			1209	0521					2004
												1226
1953	1962	1971	1980	1989	1998	2007						
1952			1979	0523		0912						
1104			1212			2006						
						1115						
2009												

Dates expressed as YYYYMMDD.
 The 56 year sequences are separated by an interval of 9 years.
Source of Raw Data: Kazuya FUJITA

World Mega Quakes

From Fujita’s catalog, the biggest world quakes ($M \Rightarrow 8.5$) were also evaluated. **Table 11a** gives a 54/56 year cycle for three of the five biggest quakes since 1900 – 1952 Kamchatka (M9.0), 2004 Indonesia (M9.0) and 2011 Japan (M9.0). **Table 11b** shows the 54/56 year grid for the 1960 Chilean (M9.5) and 1964 Alaskan (M9.2) mega quakes. Other major world quakes ($\Rightarrow 8.5$) listed by Fujita have been included in both tables.

Table 11a 54/56 YEAR CYCLE: BIGGEST WORLD QUAKES SINCE 1900 (M => 8.5) Year ending August 17								
Sq 29		Sq 27		Sq 25		Sq 23		Sq 21
						1895	+ 54	1949
				1897	+ 54	1951	+ 54	2005
						1950		Mar 28
						Aug 15		2004
								Dec 26
		1899	+ 54	1953	+ 54	2007		
				1952				
				Nov 04				
1901	+ 54	1955	+ 54	2009				
1957	+ 54	2011						
Mar 09		Mar 11						

Table 11b 54/56 YEAR CYCLE: BIGGEST WORLD QUAKES SINCE 1900 (M => 8.5) Year ending August 17				
Sq 36		Sq 34		Sq 32
				1904
		1906 Jan 31 Aug 17	+ 54	1960 May 22
1908	+ 54	1962	+ 54	2016
1964 Mar 28 1963 Oct 13	+ 54	2018		
The 56 year sequences are separated by an interval of 54 years. Events in bold were among the top quakes (M => 8.5) recorded since 1900. Source of Raw Data: Kazuya FUJITA				

These 54/56 year patterns can be combined to produce a grid based on the intervals 9, 45 and 56 years as shown in **Table 12**. This consists of repeating 9, 45, 9, 45... years on the horizontal and 56 years on the vertical (denoted as a 9-45/56 year cycle). Although it only comprises 9 56 year sequences, all five world mega quakes of magnitude => 9.0 fall in this pattern. Furthermore, of the top 17 major quakes listed by Fujita (M => 8.5), an amazing 11 fell within **Table 12**, where as 2.7 could have been expected by chance. Curiously, the two great quakes (M => 8.7) that did not show up in **Table 12** were separated by an interval of 45 years - Feb 4, 1965 (M8.7) and Feb 27, 2010 (M8.8).

Table 12 9-45/56 YEAR CYCLE: BIGGEST WORLD QUAKES SINCE 1900. M => 8.5 Year ending August 17								
Sq 29		Sq 38		Sq 27		Sq 36		Sq 25
						1908	+ 45	1953 1952 Nov 04
1901	+ 9	1910	+ 45	1955	+ 9	1964 Mar 28 1963 Oct 13	+ 45	2009
1957 Mar 09	+ 9	1966	+ 45	2011 Mar 11	+ 9	2020		
	Sq 34		Sq 23		Sq 32		Sq 21	
					1904	+ 45	1949	
	1906 Jan 31 Aug 17	+ 45	1951 1950 Aug 15	+ 9	1960 May 22	+ 45	2005 Mar 28 2004 Dec 26	
+ 9	1962	+ 45	2007	+ 9	2016			
+ 9	2018							
Events in bold were among the top quakes (M => 8.5) recorded since 1900. Source of Raw Data: Kazuya FUJITA								

The USGS listed four major quakes (M => 8.7) for the pre 1900 era, three of which appeared in the strategic

Sequence 52 - 1700 Cascadia, 1755 Lisbon and 1868 Arica quakes (see **Table 6**). However, Sequence 52 did not integrate within the 9-45/56 year pattern presented in **Table 12**.

Record Quakes by Country

There were a total of 17 record quakes by country in Fujita’s listing, which have been denoted by a # in **Appendix 7** (NB: the two 1905 Mongolian earthquakes were treated as one event). Some 9 records by country took place in the 8 56 year sequences in **Table 13a**, where as 2.4 could have been anticipated. A further six record episodes fell in the 6 sequences in **Table 13b** and included the important mega quakes in Alaska (1964) and Japan (2011).

Table 13a 9/56 YEAR CYCLE: RECORD BY COUNTRY 1900 – 2011 M => 8.2 Year ending June 30							
Sq 25	Sq 34	Sq 43	Sq 52	Sq 05	Sq 14	Sq 23	Sq 32
							1904
	1906 0131 1905 Jul 09 Jul 23	1915	1924 Jun 26	1933 Mar 02	1942	1951 1950 Aug 15 Dec 09	1960 May 22
1953 1952 Nov 04	1962	1971	1980 1979 Dec 12	1989	1998	2007	
2009							
Table 13b 9/56 YEAR CYCLE: RECORD BY COUNTRY 1900 – 2011 M => 8.2 12.2 months ending June 20							
Sq 47	Sq 56	Sq 09	Sq 18	Sq 29	Sq 38		
						1908	
1919 Apr 30 1918 Aug 15	1928 Jun 17	1937	1946	1955		1964 Mar 28	
1975	1984	1993	2002 2001 Jun 23	2011 Mar 11	2020		

Discussion

Interesting correlates have been established between record earthquakes and their propensity to cluster within the 9/56 year grid, especially around Sequences 25, 34, 43, 52 and 05. This applied to North America, Western Europe and Japan. Little can be offered to account for this observation, apart from stating that it probably was caused by Moon-Sun tidal influences. McMinn (2011) provided background information on this effect and showed how Moon-Sun cycles can be intimately linked with the 9/56 year configuration. Any events grouping in a 9/56 year pattern will have the lunar ascending node in two restricted segments sited approximately 180 degrees opposite on the ecliptical circle with no exceptions. Apogee will also be sited in three ecliptical segments about 120 degrees apart with no exceptions. How the 9/56 year seismic cycle actually functions in relation to record events remains completely unknown. Hopefully others with the requisite skills in Moon-Sun tidal harmonics will be far more successful than the author in solving this enigma.

The record quake in a particular region/country was more significant than the quake strength. Thus, the 1755 Boston quake (M6.5) in north east USA was given equal relevance as the 1906 San Francisco (M7.7) event

in California – Nevada or the 1949 Queen Charlotte Island quake (M8.1) in western Canada. What seemed relevant was the record event in a particular region, regardless of its relative magnitude.

The 9/56 year grid is the only seismic ‘cycle’ known to the author that consists of precise time units - 9 years on the horizontal and 56 years on the vertical. However, if listed chronologically, events in a particular 9/56 year pattern give the impression of randomness with no apparent mathematical structure. For example, the south west American records in **Table 1** fell in the series 1700, 1868, 1906, 1915, 1980 and 2010. The Western European records in **Table 5** happened in the years 1903, 1905, 1912, 1931, 1939, 1941, 1969 and 1980. The 9/56 year grid cannot be considered a ‘cycle’ in the traditional sense with events happening every so many years, but something much more abstract.

The author’s research in both finance and seismology achieved good correlates, but often only by breaking down the raw data into viable subsets for assessment. For example, record quakes in this paper were very significant in the 9/56 year cycle, an effect that would have been overlooked if only samples of major quakes were considered. Furthermore, major quakes ($M \Rightarrow 6.9$) in California – Nevada – Baja California were much more likely to occur in one sector of the complete 9/56 year grid (McMinn, 2011). In contrast, moderate quakes ($\Rightarrow 6.5$ to $\Leftarrow 6.8$) occurred in an 18/56 year pattern and in a completely different sector of the 9/56 year grid. This could not have been observed, if major and moderate quakes were assessed as one sample. Many other instances could have been given in finance (McMinn, 2004, 2009).

Since 1760, major US and Western European financial panics occurred most commonly in the 9/56 year pattern as revealed in **Table A, Appendix 8**. Ten sequences in this table (Sqs 52, 05, 14, 23, 32, 41, 50, 03, 12 and 21) also appeared in the 9/56 year grid for major world earthquakes in **Table 10**. Something similar could be repeated for records by US state (see **Table 2**) and records by Western European country (see **Table 5**). The 9/56 year grid for major financial crises overlapped with those grids for major earthquakes.

The importance of seasonality in some of the findings indicated that the Sun’s position on the ecliptical circle should have relevance in earthquake timing. A similar situation could also apply to the Moon’s location on the ecliptic, although no supportive evidence has been offered in this paper.

How the 9/56 year cycle functions remains very puzzling. The best avenues for further research lie in the varying angles between the Moon, the Sun, the lunar ascending node, apogee and the spring equinox point (000 E°). The rising point may also be included assuming diurnal cycles of the Moon and Sun were significant. (NB: For a particular location on the Earth’s surface, the rising point is the point on the eastern horizon at a particular time.) All these Moon-Sun factors should be assessed collectively rather than separately, although this may be difficult to undertake. Then the sunspot cycle also needs to be considered. According to Choi & Maslov (2010), earthquake frequency for the period 1973 to 2010 was “closely related to the solar [sunspot] cycle: the number of earthquakes increases during the declining/trough periods.” In recent years, many papers have been published on the links between the sunspot cycle and seismic activity. Again, it was a complete mystery how the 9/56 year Moon-Sun effect could merge with the sunspot cycle to influence earthquake activity.

Conclusions

Record earthquakes in south western North America fell selectively in patterns of the 9/56 year cycle as shown in **Table 1**, as did the record quakes in the 50 US states in **Table 2**. In both cases there was a strong preference for record episodes being timed within five 56 year sequences – Sqs 25, 34, 43, 52 & 05. This also applied to Japanese earthquakes ($M \Rightarrow 8.3$) since 1890. For some samples, significance was apparent over a much larger section of the complete 9/56 grid, as for record quakes by Western European countries (see **Table 5**) and by major world quakes post 1900 (see **Table 10**). Another curiosity was the tendency for record regional events in North America to occur in 18/56 and 36/56 year sub-cycles (see **Tables 3 & 4**), as well as 9-45/56 year cycles for the world mega quakes (see **Table 12**). For Latin America, a reliable listing of early record quakes by country could not be sourced and thus no conclusions could be drawn.

Why so few sequences contained so many record seismic events remains puzzling, although Moon-Sun tidal effects were firmly implicated by McMinn (2011). Overall, the findings on record earthquakes and the 9/56 year cycle are certainly of great interest, but very preliminary. Much more research is warranted in this area.

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Appendix 1						
RECORD EARTHQUAKE BY US STATE TO 2010 – USGS						
State	Date	UTC	Lat	Long	M	Intensity
Alabama	1916 10 18	22:04	33.5N	86.5W		VII
Alaska	1964 03 28	36:14.0	61.0N	147.7W	9.2	X
Arizona	1959 07 21	17:39:29	36.8N	112.4W		VI
Arkansas	1811 12 16	8:15	35.6N	90.4W	7.7	XI
California	1857 01 09	16:24	35.7N	120.3W	7.9	IX
	1906 04 18	13:12:21	37.7N	122.5W	7.7	XI
Colorado	1882 11 08	1:30	40.5N	105.5W		VII
Connecticut	1791 05 16	13:00	41.5N	72.5W		VII
Delaware	1871 10 09	14:40	39.7N	75.5W		VII
Florida	1780 02 06		30.4N	87.2W		VI
Florida	1879 01 13	4:45	29.5N	82.0W		VI
Georgia	1914 03 05	20:05	33.5N	83.5W		V
Hawaii	1868 04 03	2:25	19.0N	155.5W		X
Idaho	1983 10 28	06:06.5	44.0N	113.9W	7.0	IX
Illinois	1968 11 09	01:40.5	37.9N	88.4W	5.3	VII
	2008 04 18	09:36:59.1	38.452N	87.886W	5.4	VII
Indiana	1909 09 27	9:45	39.8N	87.2W		VII
Iowa	1905 04 13	16:30	40.4N	91.4W		V
Kansas	1867 04 24	20:22	39.2N	96.3W		VII

Kentucky	1980 07 27	52:21.4	38.2N	83.9W	5.0	VII
Louisiana	1930 10 19	12:17	30.0N	91.0W		VI
Maine	1904 03 21	6:04	45.0N	67.2W		VII
Maryland	1990 01 13	47:55.3	39.4N	76.9W		V
Massachusetts	1755 11 18	9:11:35	42.7N	70.3W		VIII
Michigan	1947 08 10	46:41.3	41.9N	85.0W		VI
Minnesota	1975 07 09	54:21.3	45.5N	96.1W	4.3	VI
Mississippi	1931 12 17	3:36	33.8N	90.1W		VI
Missouri	1812 02 07	9:45	36.5N	89.6W	7.9	XII
Montana	1959 08 18	37:13.5	44.7N	111.2W	7.3	X
Nebraska	1877 11 15	17:45	41.0N	97.0W		VII
	1964 03 28	08:46.5	43.0N	101.8W		VII
Nevada	1915 10 03	52:48.0	40.5N	117.5W	7.1	X
New Hamp	1940 12 20	27:26.2	43.9N	71.4W	5.3	VII
	1940 12 24	43:45.0	43.9N	71.3W	5.6	VII
New Jersey	1783 11 30	3:50	41.0N	74.5W		VI
New Mexico	1906 11 15	12:15	34.0N	107.0W		VII
New York	1944 09 05	38:45.7	45.0N	74.7W	5.5	VIII
N Carolina	1916 02 21	23:39	35.5N	82.5W		VII
North Dakota	1909 05 16	4:15	49.0N	104.0W		VI
Ohio	1937 03 09	44:35.5	40.5N	84.3W		VIII
Oklahoma	1952 04 09	29:28.4	35.5N	97.9W		VII
Oregon	1910 08 05	1:31:36	42.0N	127.0W		Felt
	1993 09 21	28:55.4	42.3N	122.0W	6	VII
Pennsylvania	1998 09 25	52:52.1	41.5N	80.4W		VI
Rhode Island	1976 03 11	29:32.2	41.6N	71.2W	2.1	VI
S Carolina	1886 09 01	2:51	32.9N	80.0W	7.0	X
South Dakota	1911 06 02	22:34	44.2N	98.2W		V
Tennessee	1865 08 17	15:00	36.0N	89.5W		VII
Texas	1931 08 16	40:22.3	30.5N	104.6W		VIII
Utah	1934 03 12	15:05:40	41.7N	112.8W	6.5	VIII
Vermont	1962 04 10	30:45.2	44.1N	73.0W		V
Virginia	1897 05 31	18:58	37.3N	80.7W	5.9	VIII
Washington	1872 12 15	5:40	47.9N	120.3W		IX
West Virginia	1969 11 20	00:09.3	37.4N	80.9W	4.5	VI
Wisconsin	1947 05 06	21:27	43.0N	87.9W		V
Wyoming	1959 08 18	56:16.8	44.7	110.7W		Felt

Years in **bold** contained US record quakes in the year beginning April 1 of those years in the Table 2.

Source: [USGS The Largest Earthquakes, State by State.](http://neic.usgs.gov/neis/states/state_largest.html)

http://neic.usgs.gov/neis/states/state_largest.html

Appendix 2			
RECORD QUAKE BY NORTH AMERICAN REGION			
Country	Record Quake	M	Location
US REGIONS			
Alaska	Mar 28, 1964	9.2	Anchorage AK
California – Nevada	Jan 09, 1857	7.9	Fort Tejon CA
	Apr 18, 1906	7.7	San Francisco CA
Central	Feb 12, 1812	7.9	New Madrid MO
Hawaii	Apr 03, 1868	7.9	Hawaii HA
North East	Nov 18, 1755	6.5	Boston MA

Pacific North West	Dec 15, 1872	7.2	Lake Chelan WA
South East	Sep 01, 1886	7.0	Charleston SC
Western Mountains	Aug 18, 1959	7.5	Hebgen Lake MT
CANADIAN REGIONS			
Central Canada (a)	May 15, 1909	5.5	Saskatchewan
Eastern Canada	Nov 18, 1929	7.2	Offshore Newfoundland
Northern Canada	Nov 20, 1933	7.3	Baffin Bay
Western Canada	Aug 22, 1949	8.1	Queen Charlotte Island
MEXICO			
Mexico (b)	Jun 03, 1932	8.2	Jalisco
<p>Events in bold occurred in the year ending November 20 of those years in Appendix 3. (a) Source: Gendzwill (2006). (b) Record event for the 20th century. Sources: USGS. <i>Historic United States Earthquakes</i>. http://earthquake.usgs.gov/earthquakes/states/historical.php Geological Survey of Canada. <i>Historic Earthquakes in Canada</i>. http://earthquakescanada.nrcan.gc.ca/history/index-eng.php</p>			

Appendix 3 9/56 YEAR CYCLE: RECORD QUAKE BY NORTH AMERICAN REGION Year ending November 20							
Sq 34	Sq 43	Sq 52	Sq 05	Sq 14	Sq 23	Sq 32	Sq 41
		1756 1755 Nov 18	1765	1774	1783	1792	1801
1794	1803	1812 Feb 16	1821	1830	1839	1848	1857 Jan 09
1850	1859	1868 Apr 03	1877	1886 Sep 01	1895	1904	1913
1906 Apr 18	1915	1924	1933 Nov 20	1942	1951	1960	1969
1962	1971	1980	1989	1998	2007		
Sq 50	Sq 03	Sq 12	Sq 21	Sq 30	Sq 39	Sq 48	Sq 01
1754	1763	1772	1781	1790	1799	1808	1817
1810	1819	1828	1837	1846	1855	1864	1873 1972 Dec 15
1866	1875	1884	1893	1902	1911	1920	1929 Nov 18
1922	1931	1940	1949 Aug 22	1958	1967	1976	1985
1978	1987	1996	2005				
<p>56 year sequences were separated from each other by an interval of 9 years. Quakes in bold happened in years ending November 20 within the table. Sources of Raw Data: USGS. Geological Survey of Canada.</p>							

Appendix 4 RECORD WESTERN EUROPEAN QUAKES SINCE 1900			
WESTERN EUROPE	Date	M	Location
France	19090611	6.2	Vernegues
Germany	19920413	5.9	Roermond
Greece	19030611	8.3	Kythera
	19260826	8.3	Rhodes Island
Italy	19050908	7.9	Calabria
North Atlantic	19411125	8.3	Atlantic Ocean
Portugal - Morocco	19690228	7.8	na
Azores (Portugal)	19800101	7.2	Azores Islands
Spain	19540329	7.9	Durcal
Turkey	19120809	7.8	Murefte
	19391226	7.8	Erizincan
UK	19310607	6.1	North Sea

Years in **bold** experienced record earthquakes during June 15 ended years in Table 5.
Main Sources: USGS. *Historic World Earthquakes*.
<http://earthquake.usgs.gov/earthquakes/world/historical.php>
 NGDC. Search parameters: Relevant country. 1900 to 2010. M: 7.0 to 9.0
<http://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=1&d=1>

Appendix 5 HISTORIC JAPANESE EARTHQUAKES 1890 - 2011 (M => 8.3) Year ending December 15						
Year	Month	Day	Location	Lat	Long	M
1891	10	28	Japan	35.5	137	8.4
1897	2	7	Japan	40	140	8.3
1897	2	19	Japan	38	142	8.3
1898	6	5	Offshore east coast Honshu	38	143	8.7
1906	1	21	Off south coast Honshu	34	138	8.4
1911	6	15	Ryukyu Islands	29	129	8.7
1914	11	24	Volcano Islands	22	143	8.7
1933	3	2	Honshu: East Coast	39.2	144.5	8.4
2003	9	25	Hokkaido	41.8	143.9	8.3
2011	3	11	Offshore north east Honshu			9.0

Years in **bold** contained the Japanese quakes in the 3.5 months ending March 5 in Table 7.
Source: NGDC. Search parameters: Japan. 1890 to 2011. M: 8.0 to 9.5.
<http://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=1&d=1>

Appendix 6 RECORD QUAKES BY LATIN AMERICAN COUNTRY 1900 - 2010								
Country	NGDC		USGS		Fujita		Other	
	Date	M	Date	M	Date	M	Date	M
Argentina	19440115	7.8	19440115	7.4	19501209	8.3	19491217	7.8
	19491217	7.8	19771123	7.4			(a)	
Brazil	19500307	8.6	20030620	7.1	na	na		
Bolivia	19571129	7.8	19940609	8.2	19940609	8.3		
Chile	19600522	9.5	19600522	9.5	19600522	9.6	20100227	8.8
							(b)	
Colombia	19000918	7.9	19700731	8.0	19791212	8.3		
	19040120	7.9						
Ecuador	19060131	8.8	19060131	8.8	19060131	8.6		

Peru	19071116	8.7	20010623	8.4	20010623	8.4		
Venezuela	19001029	8.4	19970709	7.0	na	na		
Central America	19041220	8.3	19420806	7.9	na	na		
Caribbean	19000621	7.9	19460804	8.0	na	na		
	19061203	7.9						
Mexico	19020923	8.4	19320303	8.1	19280617	8.2		

(a) Source: Instituto Nacional De Prevencion Sismica.

(b) Source: Universidad de Chile, Dept de Geofisica.

Earthquakes in **bold** contained record Latin American quakes in Table 9.

Main Sources: NGDC. Search parameters: Relevant country. 1900 to 2010. M: 7.0 to 9.0

<http://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=1&d=1>

USGS, *Historic World Earthquakes*. <http://earthquake.usgs.gov/earthquakes/world/historical.php>

Fujita, K., *Magnitudes of the Largest Events of the 20th Century*.

www.msu.edu/~fujita/earthquake/bigquake.html

Appendix 7			
MAGNITUDES OF THE LARGEST SEISMIC EVENTS: 1900 – 2011			
Kazuya Fujita (revised March 1, 2010)			
Rank	Date	Location	Mw
1a	1960.05.22#	Chile Mainshock	9.6
1b	1960.05.22	Chile “Precursor”	9.5
1c	1960.05.22	Chile “Afterslip”	9.0
2	1964.03.28#	Prince William Sound, Alaska	9.2
3	2004.12.26#	Offshore Northern Sumatra	9.0
4	1952.11.04#	Kamchatka (Russia)	9.0
	2011.03.11#	Offshore Honshu Japan	9.0
5	2010.02.27	Bio Bio, Chile	8.8
6	1965.02.04	Aleutian Islands, Alaska	8.7
7	1950.08.15#	Assam, India	8.7
8	2005.03.28	Offshore Northern Sumatra	8.6
9	1933.03.02	Sanriku, Japan	8.6
10	1957.03.09	Aleutian Islands Alaska	8.6
11	1906.01.31#	Ecuador-Colombia	8.6
12	1963.10.13	Etorofu, Kurile Islands	8.5
13	1938.02.01	Banda Sea, Indonesia	8.5
14	2007.09.12	Offshore southern Sumatra	8.5
15	1906.08.17	Valparaiso, Chile	8.5
16	1923.02.03	Kamchatka	8.5
17	2001.06.23#	Offshore Peru	8.4
18	1958.11.06	Etorofu, Kurile Islands	8.4
19	1922.11.11	Atacama, Chile	8.4
20	1952.03.04	Tokachi-oki, Japan	8.4
21	1977.08.19	Sumbawa, Indonesia	8.3
22	2006.11.15	Kuril Islands	8.3
23	2003.09.25	Hokkaido, Japan	8.3
24	1924.06.26#	Macquarie Ridge	8.3
25	1920.12.16#	Kansu, China	8.3
26	1994.10.04	Etorofu, Kuriles	8.3
27	1905.07.09#	Mongolia	8.3
28	1905.07.23#	Mongolia	8.3

29	1946.04.01	Aleutian Islands, Alaska	8.3
30	1979.12.12#	Colombia-Ecuador	8.3
31	1923.09.01	Kanto (Tokyo), Japan	8.3
32	1968.05.16	Tokachi-oki, Japan	8.3
33	1938.11.10	Alaska	8.3
34	1919.04.30#	Tonga	8.3
35	1994.06.09#	Bolivia	8.3
36	1950.12.09#	Argentina	8.3
37	1959.05.04	Kamchatka, Russia	8.2
38	1940.05.24	Peru	8.2
39	1918.08.15#	Mindanao, Philippines	8.2
40	1996.02.18	West Irian, Indonesia	8.2
41	1989.05.23	Macquarie Ridge	8.2
42	1949.08.22	Queen Charlotte Is, Canada	8.2
43	1928.06.17#	Oaxaca, Mexico	8.2
44	1918.09.07	Urup, Kurile Islands	8.2
45	1969.08.11	Shikotan, Kurile Islands	8.2
46	1960.05.21	Chile Foreshock	8.2
48	1966.10.17	Northern Peru	8.2
49	1970.07.31	Colombia	8.2
50	1924.04.14	Philippines	8.2
LARGE PRE 20TH CENTURY EVENTS - Fujita			
	1700.01.26	Great Cascadia	9.0
	1703.12.31	Kanto, Japan	8.2
	1707.10.28	Tosa, Japan	8.4
	1725.02.01	Eastern Siberia, Russia	8.2
	1730.07.08	Valparaiso, Chile	8.6
	1737.10.17	Kamchatka, Russia	8.3
	1751.05.25	Concepcion, Chile	8.5?
	1755.11.01	Lisbon, Portugal	8.7
	1792.08.22	Kamchatka, Russia	8.4
	1797.02.04	Ecuador	8.3
	1819.06.16	Rann of Kutch, India	8.3
	1841.05.17	Kamchatka	8.4
	1843.02.08	Guadalupe, Caribbean	8.3
	1843.04.25	Etorofu, Kuriles	8.3
	1854.12.23	Tokaido, Japan	8.4
	1854.12.24	Nankaido, Japan	8.4
	1868.08.13	Chile - Peru border	8.5
	1877.05.10	Iquique, Chile	8.3
	1889.07.11	Chilik, Kazakhstan	8.3
	1891.10.28	Mino-Owari, Japan	8.3
	1896.06.15	Sanriku, Japan	7.0
	1897.06.12	Assam, India	8.0
	1897.09.21	Philippines	7.9
<p># Denotes the record quake by country during the 20th century. Years in bold experienced major quakes (M => 8.2) in October 31 ended years in Table 10. Sources: Fujita, K., <i>Magnitudes of the Largest Events of the 20th Century</i>. www.msu.edu/~fujita/earthquake/bigquake.html</p>			

Appendix 8

9/56 YEAR CYCLE: FINANCIAL CRISES

Between 1760 and 1940, Kindleberger (Appendix B, 1996) listed some 30 major financial panics for the US & Western Europe, 16 of which appeared in the 9/56 year grid shown in Table A (significant $p < .001$) (McMinn, 2004). For the period 1940-1996, numerous international currency crises were included in Kindleberger's listing, only one of which appeared within the 9/56 year configuration. Even including the currency speculations, 20 of Kindleberger's 44 crisis years (1760-1989) fell in the 9/56 year pattern, which was still significant ($p < .01$).

Table A
9/56 YEAR CYCLE: FINANCIAL PANICS 1760 – 1996
Year beginning March 1

Sq 52	Sq 05	Sq 14	Sq 23	Sq 32	Sq 41	Sq 50	Sq 03	Sq 12	Sq 21	Sq 30	Sq 39	Sq 48	Sq 01
													1761
							1763	1772	1781	1790	1799	1808	1817
	1765	1774	1783	1792	1801	1810	1819	1828	1837	1846	1855	1864	1873
1812	1821	1830	1839	1848	1857	1866	1875	1884	1893	1902	1911	1920	1929
1868	1877	1886	1895	1904	1913	1922	1931	1940	1949	1958	1967	1976	1985
1924	1933	1942	1951	1960	1969	1978	1987	1996	2005				
1980	1989	1998	2007										

The 56 year sequences are separated by an interval of 9 years.
 Years in **bold** contained major financial panics and crises as listed by Kindleberger (Appendix B, 1996).
Source: McMinn, 1995, 2004.