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Pyramids and Ceremonial Centers in Mesoamerica and China: Were They Oriented Using a Magnetic Compass?

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Abstract

The arguments based on our own measurements in situ or based on analysis of satellite images and on worldwide paleomagnetic data available to date for relevant time intervals are gathered and presented to claim that many pyramids and other important buildings in Mesoamerica (Olmécs, Maya...) and in China (Xi'an...) were oriented by means of a magnetic compass.

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1. Outline

Fuson (1969) [1] and Carlson (1975) [2] claim that Olmécs and Maya knew and used a (lodestone) compass for the orientation of pyramids, ceremonial and other important buildings. Written records indicate that knowledge of an ancient type of compass in China is very old – dating back to before the Han dynasty (206 BC – 220 AD) to at least the 4th century BC. Geomancy (feng shui) was practised for a very long time and had a profound influence on the face of China's landscape and city plans.

Fuson's hypothesis has been tested with the aid of the paleomagnetic declinations for time and areas of Olmecs/Maya and central China with orientation data of buildings based on our measurements at various archaeological localities of México, Guatemala, and in Copán in Honduras by GPS and with a precise compass during 2003-2010. In China (Xi'an and Luoyang provinces) we had to rely upon satellite images from *Google Earth* (now with excellent resolution of few meters in many areas).

After eliminating known astronomical and calendar orientation of some buildings, we have found that there is majority of structures with an orientation that clearly deviates from geographic north (pole of rotation of the Earth). When trying to explain this, we can rule out pure chance, local topography, aesthetic, meteorological or defence reasons. The structures might be oriented by means of a magnetic compass.

The use of the compass means that the „needle“ was directed towards the actual „magnetic pole“ (roughly speaking) at the time of construction of the respective pyramid. However, the magnetic pole, relative to the nearly 'fixed' geographic pole (the pole of rotation of the Earth), moves significantly over time; changes in its direction ~10 degrees per century, as observed from the given locality, are not exceptional.

By matching measurements of buildings' orientation (Table 1, Figs. 2-3, 5-7) with modelled paleomagnetic history (Figs. 1, 4) [3], [4], we found a fair correlation between the date of pyramid construction and their space orientation relative to the magnetic pole positions at the respective time of construction (Fig. 4). Thus, the Fuson's hypothesis can explain the observed sites layout and building orientations in Mesoamerica (Klokočník et al., 2007) [5] as well as in China (Charvátová et al., 2010) [6], in majority cases.

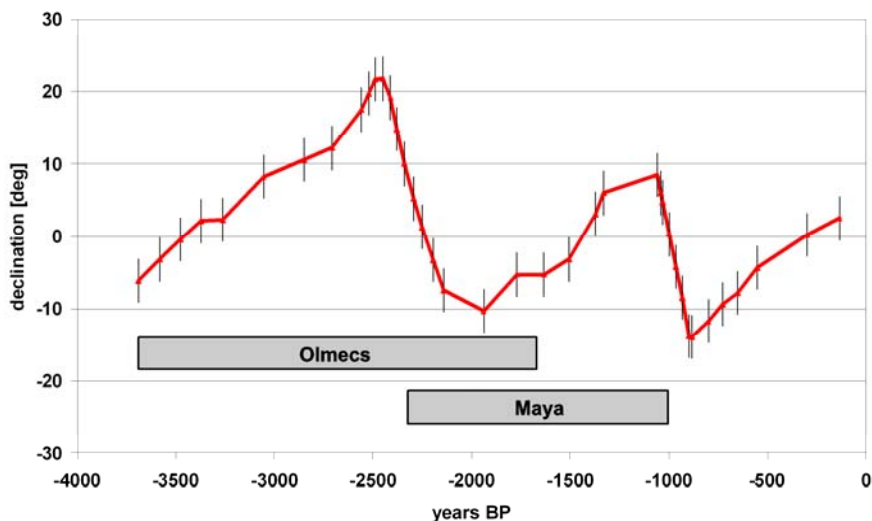


Fig. 1. Paleomagnetic declinations for Yucatan, México, according to Böhnelt ([3] and priv. commun.) for the time interval 2000 BC - 2000 AD. Symbol BP means "before present".

The deviation of the declination from the north geographic pole is plotted in degrees, positive values are to the East. The precision is indicated by error bars.



Fig. 2. Monte Albán, Oaxaca, Mexico; a map (north to left) and image from Google Earth (north up). Building “L” (called in literature building J) has astronomical orientation, but the others might be oriented by a compass (for more details and examples with different declinations see [5]).

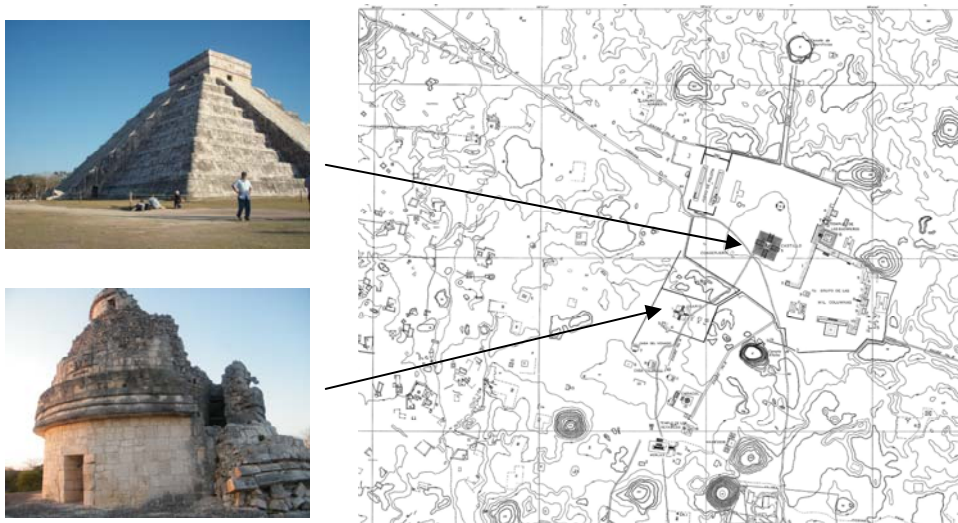


Fig. 3. Plan of Chichén Itzá, Yucatan, Mexico, according to the US mapping project (© Joel Skidmore, © Ed Barnhart 2000). Kukulcán (Quetzalcoatl) pyramid also called Castillo (upper left - photo at spring equinox, © J. Klokočník, 2010) and Caracol (the observatory, *ibid*) have astronomical orientation. But some other structures may be oriented by means of a compass (see Klokočník et al, 2007).

Table 1. A list of tombs at the *Xi'an* (1 - 22, 24-26, 33, 34) and *Luoyang* areas (23, 27-31) in central China with their geographic coordinates (latitude, longitude east of Greenwich (degrees and minutes of arcs), information about the dynasties and the reign period of the relevant emperor/empress, from [8] and the orientation of tombs with respect to the north geographic pole (*E* ... East of north pole, *W* ... West of north pole, in degrees) as measured by *AutoCAD 2004LT* software from the *Google Earth* printings.

#	coordinates		name of the object	dynasty emperor	Period of reign	orientation degrees
	latitude	longitude				
1	34 24	108 44	Kangwang Maus.	Western Zhou, Kangwang	1020-966 BC	0-2 E
2	34 23	109 15	Shihuangling	Qin, Shihuangdi	246-210 BC	3 E
3	34 26	108 53	Changling	Western Han, Gaozu (Lu)	206-195 BC	10 W
4	34 27	108 57	Anling	Western Han, Huidi	194-188 BC	2-3 E
5	34 27	108 57	Anling	Western Han, Zhang	194-163 BC	2-4 E
6	34 25	108 50	Anling, Jinhe	Western Han, related?	194-188 BC?	12-15 W
7	34 25	108 51	Anling, Jinhe	Western Han, related?	?	10-12 W
8	34 26	108 52	Lüzhi Maus.	Western Han, Lüzhi	187-180 BC	10 W
9	34 24	108 44	Baling	Western Han, Wendi	179-157 BC	12 W
10	34 26	108 56	Yanling	Western Han, Jingdi	156-141 BC	2-3 E
11	34 20	108 34	Maoling	Western Han, Wudi	140-87 BC	8 W
12	34 20	108 35	Xianyang	Western Han, Yuanshou	122-117 BC	4-8 W
13	34 20	108 35	Xianyang	Western Han	?	4-10 W
14	34 20	108 36	Xianyang	Western Han	?	8 W
15	34 20	108 36	Xianyang	Western Han	?	14 W
16	34 21	108 38	Pingling	Western Han, Zhaodi	86-74 BC	7 W
17	34 21	108 38		Western Han, Xiaozhao	86 BC	7 W
18	34 11	109 01	Duling	Western Han, Xuandi	73-49 BC	0
19	34 24	108 43	Weiling	Western Han, Yuandi	48-33 BC	1 E
20	34 22	108 42	Yangling	Western Han, Chengdi	32-7 BC	10 W
21	34 24	108 44	Yiling	Western Han, Aidi	6-1 BC	0-2 E
22	34 23	108 42	Kan(g)ling	Western Han, Pingdi	1 BC-5 AD	1 E
23	34 84	112 60	Guangwudiling	Eastern Han, Guangwudi	25-57 AD	3-4 E
24	34 24	108 46	Tailing	Sui, Wendi	581-604 AD	0-2 E
25	34 13	108 58	Big Wild Goose Pagoda	Tang, Gaozong	650-683 AD	-
26	34 28	108 48	Shunling	Tang, Wuzetian	684-705 AD	6-8 W
27	34 40	112 57	Yongchangling	Song, Taizu	960-976 AD	3 E
28	34 40	112 57	Yongxiling	Song, Taizong	976-997AD	2 E
29	34 42	112 58	Gongy	Song, Zhenzong	998-1022 AD	2-3 E
30	34 45	112 59	Gongy	Song, Renzong	1023-1063 AD	1-2 E
31	34 45	112 59	Gongyi	Song, Yingzong	1064-1067 AD	2 E
32	39 53	116 23	Beijing, Forbidden City	Ming, Yongle	(1406-1420 AD)	3-4W
33	34 13	109 06	Bashui river	?	?	24 E
34	34 14	109 07	Bashui river	?	?	22 E

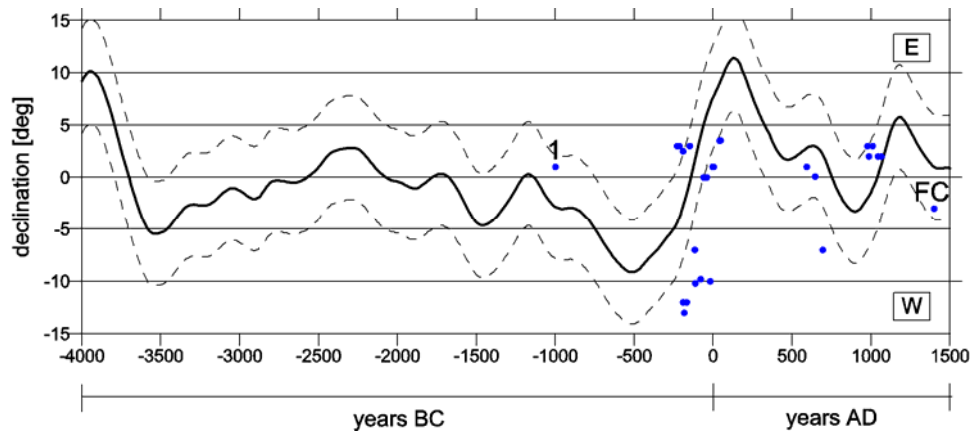


Fig. 4. Paleomagnetic declinations for the region of central China area, according to the CALS7K.2 model [4] for the time interval 4000 BC till 1500 AD. The precision of CALS7K.2 has been estimated by the authors of the model to be about 5 degrees, indicated by the dashed lines around the paleodeclination curve. Number 1 corresponds to number 1 in Table 1, FC stands for the Forbidden City, Beijing.



Fig. 5. The pyramid known as Maoling “mausoleum”, in Xi’an (Sian) area in central China, dynasty Western Han, emperor Wudi 140-87 BC, see No. 11 in Tab.1, eye altitude ~2 km, size 235 x 240 m. Source: Google Earth 2010 and <http://www.maps-china.com/Xian>. Source for ages of all the pyramids in central China in this paper: Moule, 1957 [7].

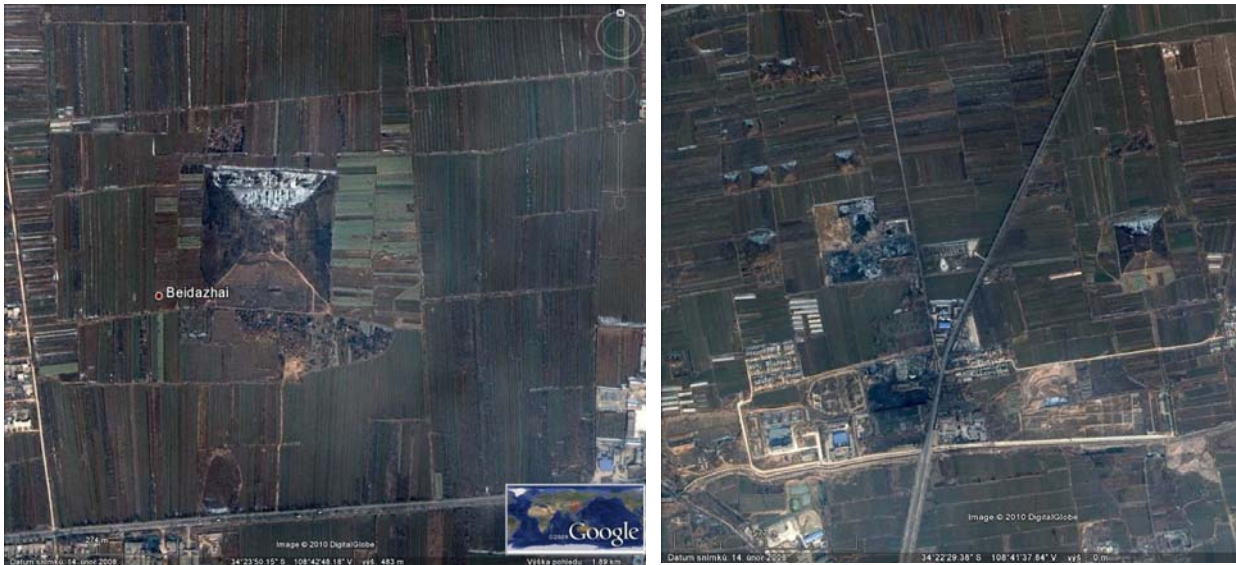


Fig. 6 (left). Pyramid Weiling, Xi'an area, dynasty Western Han, emperor Yuandi, 48-33 BC, No. 19 in Tab. 1, eye alt. ~2 km, size 165x165 m. Google Earth 2010.

Reader can use geographic latitudes and longitudes in Table 1 to find all the pyramids mentioned in Table 1 using *Google Earth* or images from other satellite sources.

Fig. 7 (right). Yangling and a row of pyramids, Xi'an area, dynasty Western Han, emperor Chengdi, 32-7 BC, No. 20 in Tab. 1, altitude about 1.6 km, size of the largest pyramid ~ 170 m, orientation 10° west. *Google Earth* 2010.

2. Conclusions

The Fuson hypothesis about possible orientation of Olmecs, Maya and other ceremonial centers by (paleo)magnetic pole, using a magnetic compass cannot be simply rejected in the light of existing facts; it still provides an explanation for the “strange” alignments, where the other interpretation (as astronomical-calendric) are not helpful. Our measurements and computations from 2003–2010 support this hypothesis both for Mesoamerica and central China. The Chinese case is clearer, because we know that Chinese used a rudimentary magnetic compass for divination purposes from “time immemorial”.

More precise and more extensive information from geodesy (more reliable and detailed maps of the archaeological localities and satellite images with a higher resolution), from astronomy (the correlation between Mayan and our calendar), from archaeology (age of the structures, namely the absolute age for the buildings in Mesoamerica), and namely better paleomagnetic declinations (everywhere in the world) are needed to finally reject or accept that Olmecs/Maya and Chinese actually used compass for planning site layouts. The preliminary answer is: yes, both civilizations used a magnetic compass for (among others) orientation of their buildings and ceremonial centers. Also the question of primacy, Chinese or Olmecs, and possible relationships between these cultures, is legitimate, very interesting and should be answered.

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