THE DESTRUCTION OF THE CITY OF AKKAD BY A COSMIC ASTEROID IMPACT AND THE LINK TO GLOBAL CLIMATE CHANGE

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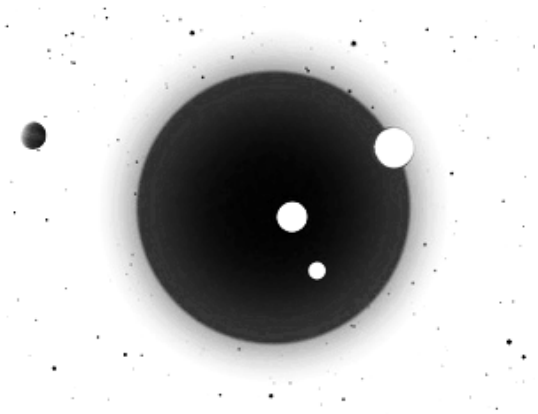

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THE DESTRUCTION OF THE CITY OF AKKAD BY A COSMIC ASTEROID IMPACT AND THE LINK TO GLOBAL CLIMATE CHANGE

Joachim Seifert, Frank Lemke

Abstract. We focus on one of the most important events in human history, the 4.2 kiloyear event, when great civilisations around the world collapsed into anarchy and social chaos. From this moment on, climate cooling and widespread aridification began, lowering agricultural food production and human living conditions. Various hypotheses exist about its cause; the most promising approach links the 4.2 kiloyear event to a cosmic asteroid crash into Mesopotamia. The asteroid landed in a densely populated area; we examine at first major translations of preserved Sumerian documents on details and progression of this catastrophic event. We quote major impact features as observed by historical Sumerian eyewitnesses. The impact, as a full strike, eradicated the Imperial city of Akkad. The impact damaged all other Sumerian towns to different degrees. Based on our findings, we identify the location of the missing city of Akkad. We analyse the onset of global cooling and severe aridification in the framework of our cosmic climate footprint analysis for a selected 1,000 year timeframe. This footprint analysis of Holocene climate change affirms the occurrence and date of the impact event. We also identify volcanic mega-eruptions, which are responsible for multi-decadal global temperature dips but which cannot cause centennial-long climate changes. The footprint analysis takes 5 climate macroforcings into account and explains global cooling and aridification based on impact-related causes.

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CONTENT:

1. GENERAL INTRODUCTION TO THE EVENT

The 4.2 kiloyear event [1] marks an unusual and still unresolved period in human history. Intertwined are a catastrophic event, a collapse of human civilisations in Mesopotamia, in Egypt, Crete, China and Latin America, a generation long lasting social chaos, the disappearance of the first human Empire of the Akkadians, together with its ruling dynasty, and an instant disappearance of the Akkadian capital city. A giant dust plume soaring over Mesopotamia was reported by contemporaries. An abrupt climate change into a prolonged period of severe aridification commenced, as evidenced on all continents. Exceptional low Nile floods and missing precipitation in Middle Eastern regions is documented. A rapid temperature drop on higher globe latitudes set in, as proven in Greenland ice core climate studies. Rapid climate cooling and the onset of aridification is assumed as having been caused by volcanic mega-eruptions or by a comet or asteroid, crashing into Mesopotamia. The 4.2 kiloyear climate change event attracted the interest of climate modellers. But all their models, peer

reviewed and provided with laurels, cannot claim accuracy as latest model-data comparisons prove [2]. Obvious reasons: All models exclude 5 major climate macroforcings [3], are based on a general circulation of microforcings (GCMs), unable to demonstrate individual microforcing effects in Holocene temperature data, not to mention to provide an explanation for the 4.2 kiloyear climate change event. As alternative, research turned toward cosmic impacts. Scientists include B. Masse, S. Master, E.M. Shoemaker, D.W. Hamacher, M.A. Courty, and many others, who are certain that cosmic impacts are a major cause for climate change and civilisation disasters.

2. DESCRIPTION OF THE IMPACT EVENT

2.1. Impact site and its geological conditions

The 4.2 kiloyear event, as an asteroid, comet or cosmic impact, occurred in the geographic triangle Nasiriya-Basra-Amarah in Iraq. The area is a marshy flood plain, a large sedimentary basin, built by 4 major rivers including Euphrates and Tigris. Holocene sediments make up the top 20 meters, Pliocene sediments start in 170 m depth. Sediments are filling a gap between 2 large tectonic plates and therefore have a depth of up to 12 km [4]. Underground air filled “domes”, related to salt or limestone deposits or volcanoes are impossible to exist, therefore, no ground subsidence sinkholes above underground voids may be found. This is an important aspect because the most frequent argument, overly repeated against impact crater research, points to collapsed underground domes.

The impact site was the shore line of the Persian Gulf. The water level at the impact site was shallow, described as about 10 meters deep [5]. The boundary extent of the shallow marine Gulf estuary is given in figure 5 of [6]. The major impact structure is called the Umm-al-Binni lake [16], located West of the Amarah-Basrah road. Figure 1 shows the impact locations. The impact produced several impact craters in the area, because, as in most cases, an asteroid breaks into fractions shortly before the impact, due to its immense heat. Several craters form a so-called ´strewn field´.

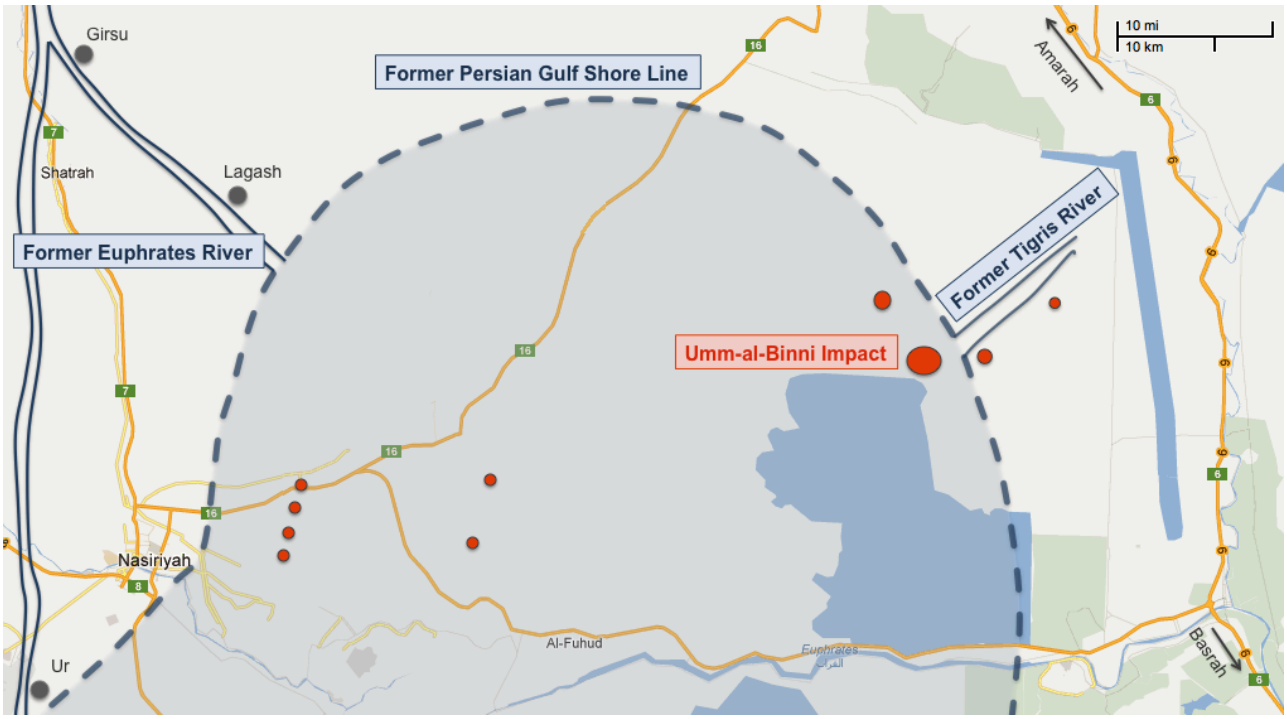

Figure 1. Impact locations. (map: Google)

2.2. Progression of the impact event

We will start with the bolide´s approach in the atmosphere. The bolide was seen from Earth in advance, as approaching comet, 15 days before impacting Earth [7]. The bolide disintegrated into several fragments, shortly before its impact into shallow waters of the Persian Gulf . The impact into

a 10 meter water depth instantly vaporised the water on contact with 2,000 °C hot bolides. We may assume a modestly high water wave, but the site was too shallow to produce a tsunami. Historical impact descriptions do not mention a sea-front tsunami. The impact occurred late in the evening, but still in daylight. As next, witnesses saw an enormous intense sky lightening and could hear the impact sound [8], a massive heat wave propagated [9] and all bolides disappeared deep in soft river delta sediments.

From this moment on, the cooling down process of bolides, stuck deep in sediments commenced and continued, sustained by inflowing Gulf waters into the craters: The water and the mud around all bolides heated tremendously and rose as giant dark mud plumes high in the air. The plume formation above all craters did not abate, as additional Gulf waters poured into impact craters, thus loosening and supplying more mud. The mud particles were lifted into the air by the ultra-hot steam. In the atmosphere, under steam participation, mud particles agglomerated to hail-sized pebbles, described as "pellets" [10], which rained down, glowing visibly, miles away, to the ground [9, lines 179-187]: "[...] a fiery glow burns with the raging storm [...]" and [11, lines 79-92]: "the dark time was roasted by hail-storms {of pebbles} and flames" and on the ground [9, lines 192-196]: "the scorching potsherds made the dust glow [...]". The cooling time of bolides took 24 hours, i.e. one night and the following daytime [8]. On noon next day, the sun was recognisable through the dust haze again. Mud plumes over impact sites were ´cooked´, sterilised, without biological micro-life, and contained much sea salt from Gulf waters. The mud plumes could not lift larger diameter sediments, such as stones and gravel high enough into the air. Those heavier sediments rose somewhat, like a fluidized bed in combustion technology, and continued to fall back into the crater, thus forming pebbly steam cones in the ground above stuck bolides, from where fine clay fractions continuously steamed out due to inflowing Gulf waters. Clay pebbles agglomerating in the dust plume in the air contained unusual and rare high temperature clay spherules, which only form at temperatures of more than 1,000 °C [10]. The mud plume moved with the prevailing wind direction, toward Northwest, depositing the mud into this direction [12] and not into the opposite South-East [13].

A homogenous mud clay layer covered the impact area within 24 hours, towns, villages, fields, rivers, irrigation channels, the whole countryside. The greater the layer thickness, the closer to the impact site. This burying of the entire country was a supernatural event for all Sumerian inhabitants, as a message and punishment by gods, as historical "City Lament" tablets prove.

Today, cosmic impact theories calculate the impact strength by a multitude of Hiroshima bomb effects. All those theories, however, do not consider real impact conditions of the event. There was no energy release on a hard, rocky surface, propagating a blast wave above ground. Instead, bolides immediately disappeared into soft alluvial sediments and their energy was steamed out via ultra-hot vapour-mud plumes into the atmosphere, soaring from.deep out of estuary sediments.

The impact site lay within a major populated area. This gives us the chance to examine, what contemporaries reported on the event. We will go straight into the original Sumerian tablet translations.

2.3. Historical impact witness narratives

A large number of Sumerian impact accounts are preserved today, which were made by observers in different cities, those tablet scripts are named City Laments.

The most important impact account is the "Lament for Urim" [9], of which 92 texts are preserved. Quotes are taken from the text, comments in {brackets} are added. The mud-fall from the sky is translated as "storm" or "flood" or "flood storm".

The text is an eyewitness account of a woman [9], who "did not flee and trembled on account of that night [...] the awesomeness of this storm, truly hangs heavy on me {but} [...] I did not forsake my Land [...]". She reports on [9, line 390-398]: "The great

storm of heaven [...], the malicious storm, which swept over the land, which destroyed cities. [...] May that storm, like rain pouring down from heaven, never recur [...]".

Details of the storm: "In front of the storm, heat blazes", "Enlil {storm god} hurled flames", "in the night, he redoubled the South wind [...]". "My house was pushed over on its side like a garden fence", "the {mud} storm covered Urim like a garment, {the mud pebbles} spread over it like a linen", "the swamp {mud cover} accumulated in the city has swallowed my possessions [...] like a flood storm it completely destroyed the city". The storm was over, the following day, with "the city reduced to ruin mounds", "corpses were piled", "possessions were scattered about [...]", the river bed was dry, filled with "dust" mud; [9, lines 265-274] to obtain drinking water, people "dug foxholes there" because, in the river bed [...] "in its midst, no flowing water is carried [...]"

The second account of the impact is given in the Epic of Gilgamesh [8]. This account was made observing from a different town, in larger distance, which the heat wave did not reach, but from there the bolide smoke trails were visible in the air: "And seven Judges of Hell, the Anunnaki, raised their torches, lightening the land with their livid flames [...]" {Intense light in the sky and 7 smoke trails, visible to the spectator}, "[...] A stupor of despair went to heaven, when the god of the storm turned daylight into darkness, when he smashed the land like a cup [...]" {the impact sound and dust plumes soared up} "[...] One whole day the tempest raged, gathering fury as it went, it poured over the people like tides of battle [...]" {mud pebbles rained down from above, as in ancient battles: arrows and stones} [...]" [...] a man could not see his brother, nor the people be seen from heaven [...]" , "even the gods were terrified at this flood, they fled to the highest heaven, the firmament of Anu [...]" {people tried to avoid being buried under collapsing roofs, leaving their houses, trying to get to higher ground, staying on top of the mud layer} [...] they crouched against the walls, covering like curs [...]" {people seeking cover from the bombardment}.

More details provides a further account [11, lines 69-92]: "[...] people, [...] breathed only with difficulty [...]". The heat blaze at night "roasted the dark time by hail-stones and flames [...] the storm was a harrowing coming from above, the city was struck by a hoe [...]"

The falling mud agglomerates or pellets are described as "hail-stones". This term characterises very well the downpouring hail-grain sized, hard, hot and round mud pebbles or mud pellets, heating both air and land surface.

Another City Lament for the town of Eridu [14, lines 8-10] reports: "The roaring storm [...] covered Eridug like a cloak, was spread over it like a sheet [...]" Eridu suffered the same fate as more Sumerian towns.

The fifth account is the "Song of Ullikummi", a mystical description of a meteor impact and a perished city [7], belonging to this historical age and event location. In this description, the Imperial town of Akkad is eradicated:

The impact related content deals with an evil god who spotted a great rock in a water pond, turned it as helper into a supernatural rock monster, lifted the monster up towards the sky. The monster shape in the sky resembled a spear point "Ullikummi, like a spear point he sprang", was visible from Earth: The monster {comet trail} grew in length for 15 days. The rock monster in the sky was ordered to wipe out "the beloved town of Kummiya of the sky-god" - and the evil god was set to "take Kummiya, the dear town, temple and dwelling [...]" The struggle starts: "the sky god sprang up on his cart [...] and went with thunder down to the sea and fought him, the sky god fought the {meteorite} stone [...]", in the air, while it was raining and thundering. The impact produced mud clouds: "The Sun god turned [his face] and from his anger his [shine, appearance] became altered". The location was at the Persian Gulf: "the God Kumarbi set out from the town of Urkish and to the Cold Pond he came" {the Persian Gulf, its waters colder than inland ponds}. He reached the city "Kummiya" at the Cold Pond {Akkad as a port city}, The rock monster fell from the sky and Kummiya was destroyed.

Better details for the destruction of Akkad can be found in the "Curse of Agade" [15]:

An assembly of gods cursed the town of Akkad, and ordered the storm god Enlil, to destroy this town; and "Enlil, the roaring storm,that subjugates the entire land, the rising deluge that cannot be confronted, was considering what should be destroyed [...]" [15, lines 149-179]. Enlil went into action: "The life of Agades sanctuary {Akkad} was brought to an end, as if it had been the life of a tiny carp in deep waters" {an end through deep inundation, not by blowing wind}. The mud downpour was enormous, reaching a layer level higher than city gates: "The doors of the city gates were covered with mud [...]" [lines 149-175] [...] inundated and no more visible, taking into account that Akkad was fortified "with portals of city gates" and a high "city wall [...] like a mountain, reached the heavens". [lines 40-56] . We can estimate the mud layer thickness to be of at least 20 meters..

The cosmic impact affected 3 cities most: Akkad, Lagash and Ur. Other Mesopotamian cities, further away from the impact site, were covered to a lesser extent.

The city of Akkad was instantly and entirely buried, being in closest distance to the major Umm-al-Binni impact site. Its ruling dynasty of Shar-kali-Sharri could not escape. The same fate suffered the second seaport town of Lagash. The third town, Ur, was only covered to the roof tops, located in greater distance. More details on the situation after the mud plume abated, is given in point 2.5, dealing with the event´s aftermath.

2.4. Geological evidence on the ground

All bolides have crashed into the shallow marine estuary waters of the Persian Gulf. The largest impact site is called "Umm-al-Binni" [16]. Its location is at 31°14´21.40´´N and 47°06´32.72 E with a 3 km diameter. Close by, at 31°17´24.75´´N and 47°03 ´37.83´´E, we found a smaller crater with a bubble circle of burned mud. Other impacts, forming a North-South line are two, one at 31°10´52.58´´N and 46°39´36.91´´E and the other at 31°07´´54.98´´N and 46°38´51.73´´E. Four more in N-S line exist from 31°07´46.64´´N and 46°28´37.64´´E down to 31°02´14 ´´N and 46°27´21.30´´E. Those impact craters in Gulf waters were filled by continous river sedimentation

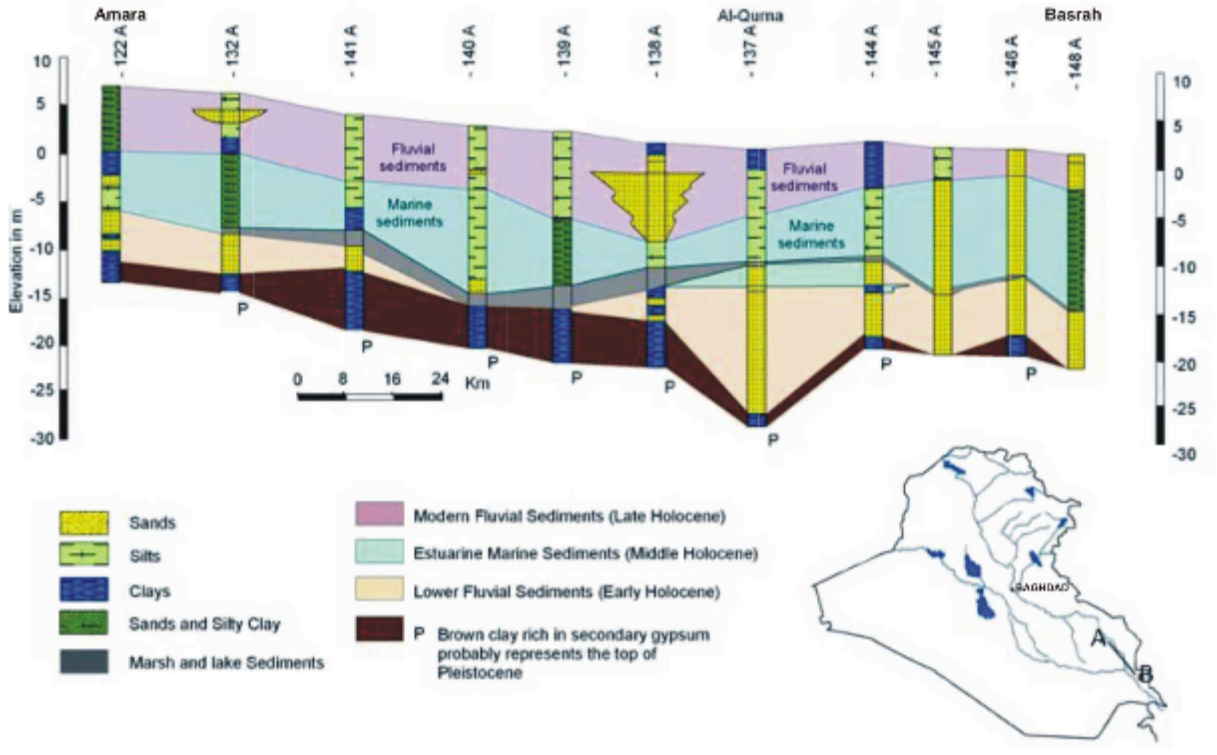

Figure 2. Subsurface profile from Amarah - Basrah according to [6].

and sand deposition by winds. Only flat crater shapes remain visible on the surface. One small impact hit the solid ground onshore, therefore, forming a deeper crater than those in the water. Its location is further East at 31°15′01.27′′N and 47°10 ′19.20′′E.

We will focus on a geological cross-section of the area [6] by S. Yacoub (fig. 2).

This stratification passing N-S through the area shows a periferical cut of the steaming cone above one bolide in the ground. This steaming cone above the bolide, consists of only coarse sand, pebble and gravel, with all fine fractions steamed out and lifted into the atmosphere. The cone interrupts the regular layer stratification. The gravel steam cone in the ground is sufficient evidence for the impact crater. The steam cone in this geological graph is located 10 miles North of Quro.

The impact mud layer is thickest around impact sites, up to 20 meters. The layer decreases with increasing distance to the impact site, reaching 5 meters [6, p. 58] Northeast of Nasiriya, decreasing further to 2.6-3.5 meters at Ur [17]. More Sumerian towns, such as Uruk, Nippur and Kish were buried, but to a lesser height. The aeolian mud moved 500 km towards North Mesopotamia. There, the town of Tell Leilan, for example, in spite of its large distance to the impact site, received a 20 cm mud layer. The impact occurred in winter time, because a strong Southern wind redoubled at the impact day [9]. Therefore, mud plumes moved Northwest, covering all of Mesopotamia. The opposite direction South, the Gulf of Oman [13] did not receive aeolian dust from this event. If the impact had happened in summer time, the annual prevailing strong summer wind called Shamal would have carried the mud plumes out to sea, into the opposite direction, towards the Gulf of Oman. The Northwest movement of the plume was even identified as very thin layer, in France and Spain, and further across the Atlantic towards the American West Coast [10].

The 20 cm thick North Mesopotamian mud layer were subject to intensive laboratory studies. . Archeological soil samples from Tell Leilan were classified by H. Weiss [18] describing the layer as “in excellent preservation [...] with a high amount of phytolites [...] of long distance aeolian transport”. Most interesting is that the long-distance dust plume separated itself during the aeolian advance in 3 parts: The bottom 10 cm of the Tell Leilan layer consisted of coarser, sand-sized mud pellets, onto which a 10 cm pure dust layer settled and finally, a torrential rain sealed the layer from above. The detailed mud composition is given by M.-A. Courty [10]. She proved that up to half of the top dust layer is made up of micro-spherules, which are produced by temperatures around 1,000 C. Additionally, the dust contains a high sea salt content plus exotic gypsum micro-structures, which can only form in presence of steam and under high temperatures.

2.5. Impact aftermath and generation-long social anarchy

2.5.1. Political situation

The impact of 2193 BC buried the imperial city of Akkad entirely, because of its location, next to the major Umm-al-Binni impact site. The Akkadian dynasty under king Shar-kali-Sharri perished and none or few of city dwellers survived. The Sumerians had the custom at this time to count years with specific year names: Years before 2193 BC were military victory years of the dynastic king over Elam, Zahara and Gutium. But, regarding the impact year, the name is different: “The year, in which Enlil {the storm god, acted} [...] onto Shar-kali-sharri” [20]. From this time on, Shar-kali-sharri ceased to be year name provider.

As a second town, the city of Lagash was buried. According to the Lagash lament: “After the flood {mud} has swept over and brought about the destruction [...] the seed of mankind was preserved [21]: People survived, but the Euphrates river bed was obstructed by the mudfall and did not reach Lagash: “In those days, the water of Lagash was held back [...] there was no water to irrigate [...]”.

The Lagash population restored the up-river town of Girsu at first, 25 km NW, and founded a Neo-Sumerian kingdom there, after 40 years of land restoration.

The third town, Ur, received less mud, only reaching roof tops.

The first people to perish by the event were those who happened to be in open air, getting caught by the heat wave, released by the impacts: [9, lines 186-187] "[...] in front of the storm, heat blazes [...] and in [22]: "scorched the body of the people [...]". Afterwards, [9, lines 216-217]: "in all streets [...] corpses were piled [...] corpses, like fat left in the Sun, melted away [...]" {by the heat of hot pellets on the ground}.

The Urians blamed the disaster onto the Akkadian rulers in town for sacrilege, because Akkadians, shortly before, destroyed a holy Sumerian temple site in Nippur: "The good house {temple of Enlil} of the untouchable mountain [...] was entirely devoured by large axes. The people of Cimacki {the Akkadians}, and Elam, the destroyers, counted its worth as only 30 shekels. They broke up the good house with pickaxes". This crime against a major Sumerian temple incited the Urians to murder all Akkadians in town [9,lines 218-240]: "men slain by the axe [...]", "men struck down with the spear", "he who stood up to the weapon was crushed with the weapon [...] he who ran away was overwhelmed [...] they lay in their own blood [...]". The Akkadian government in town was eliminated: "the Lands ´Judgement disappeared [...] the Land´s Counsel was swallowed by the swamp [mud]" [...] "it´s tax collector is gone [...]" Murdering of Akkadians spread to other Sumerian towns [15, lines 190 -244]: "The gods cursed Agade severely: City, you pounced on E-kur", and in revenge: "Alas for the E-kur!" [...] "heads were piled up. {as pyramids of heads} [...] honest people were confounded with traitors [...] the blood of traitors ran upon the blood of honest men." Akkadian dead were stripped of their clothing and not prepared for proper burial [15, lines 218-229]: "heads of the men slain by the axe were not covered by the cloth [...] men, finished off with the battle mace were not bandaged {wrapped in burial cloth} [...] they lay in their own blood as if in the place where their mothers had laboured [...]" Anarchy and violence broke out, no Akkadian official survived.

The town Girsu, at the Euphrates river, recovered first, after 40 years, under the governors Ur-Baba and Gudea of Lagash. There, new government buildings were constructed. The restoration of Lagash town focussed on their pre-Akkadian, old Sumerian temples. Soon, the Girsu rule extended over the town of Ur, where town restoration took longer. Forty years later, the town of Ur was capable of taking over Sumerian rule from Girsu. From 2112 BC on, the Neo-Sumerian Kingdom continued out of Ur, as Ur III dynasty.

A very important documentary observation is that from 2193 BC impact on, all historical records on Akkad abruptly and entirely cease: All Akkadian rule in Sumeria, the existence of Akkad town, Akkadian economic and suzerainty relations, tax and trade records, construction activities...even the Akkadian language was discontinued and replaced in written tablets by the previously used Sumerian language.

The last ruler of Lagash in 2193 BC was Puzur-Mama, under Akkadian suzerainty and credentials as {God}: "sharrum" or "lugal" . After the event, he, certainly, suffered the fate of Akkadians in other Sumerian towns and the ruling title in Girsu and Lagash, after the end of the social chaos, changed to "ensi", governor, in Sumerian.

The Empire of Akkad has instantly perished. Only title claims from unconfirmed locations, further up North in Mesopotamia, remained: The Akkadian king title itself was attractive: "King of Kings" or "King of the 4 Quarters of the Universe". The city of Akkad, however, still remains, undiscovered, under clay cover, now, for over 4,200 years. The location of Akkad town as Gulf port city was unfortunate [11, lines 22-68]: "Enki has altered the course of the Tigris and Euphrates [...], Enki blocked the water of the Tigris and Euphrates [...]" Later on, river works restored an continuing Euphrates flow to Lagash and Ur. The Tigris received the largest Umm-al-Binni impact, shifted laterally, which ended Akkads favourite sea port position as capital location at the mouth of the Tigris river, reason to abandon this site instead of renewed human settlement.

The aftermath of the cosmic impact was political anarchy, social chaos, inflation, starvation, emigration. At the same time, an absence of authority was an invitation to Sumerian neighbours,

ready to take advantage of the chaotic situation and the disaster.

2.5.2. Damage to the countryside

The generation lasting damage was twofold:

At first: The immense clay layer, dumped onto the countryside, covered all rivers in South Sumer [11, lines 58-68]: “Enki blocked the water in the Tigris and Euphrates [...] its river bed was empty, no water flowed [...]” The entire agricultural irrigation system, channels and levees, which was dug and constructed over centuries worth of work of foregoing generations disappeared: “[...] gone were the orchards and the cultivated land [...] hunger spread [...]”[9]. A list of rulers and the names of the irrigation channels dug under their reigns is given in [21] all of them gone with the impact. The look of the countryside seemed [15, lines 170-175] “as if it had been before the time, when cities were built” and irrigation cultivation just started.

The second, more important aspect of the destruction of irrigated fields was the mud´s high sea salt content, making the river water unsuitable for irrigation: After several flushes, plants would die off [15, lines 270-271]: “may brackish water flow in the river where freshwater flowed for you [...] and on that very day, so it was! [...] and Agades flowing fresh water flowed as brackish water.” This terminated the irrigation agriculture: [15, lines 170-175]: “arable tracts yielded no grain, irrigated orchards yielded no syrup nor wine” The freshwater fishes {carp} died in brackish water: “the inundated tracts yielded no fish” [...] Furthermore, the bolide´s heat “cooked” and sterilised the soil, burned all organic matter, producing infertile soil. This soil is described as biologically “lifeless”: “Not even earthworms could live in it” [18]. Additionally, the aridification after the impact date set in and the ensuing drought lowered the river water level by 1.50 m.

The population was discouraged from agriculture with high salt levels in irrigation waters [21]: “{God Acnan} did not make barley grow, [...] furrows were not opened, they bore no yield, the high plain was not tilled, it bore no yield”. People suffered severe starvation and were discouraged: “{men} did not do any work [...] became smaller and smaller”.

But there was still plant growth of salt resistant weeds and bushes [9, lines 274-368]: “my fields, [...] have grown tangled weeds [...] and thornbushes [...] the Teme weed grows in the middle of waterways, which were once suitable for barges [...] and mountain thornbushes grow on your roads, which have been constructed for wagons” [15, lines 256-271]: “may grass of mourning grow on your highways [...] and on canal bank tow-paths” Surviving people were deprived of their irrigation agriculture and had to live on domestic animals and gardening with collected rainwater from roofs [15]: “people made gardens grow within cities and not [...] on the wide plains outside”.

2.5.3. Neighbouring peoples taking advantage of the Sumerian disaster

People from the North:

As salt resistant weeds proliferated on previous irrigation fields and Sumerian authorities continued to be absent, nomadic tribes from the mountains in the North migrated South into Sumerian lands. Those tribes were no military troops, but groups of people settling with tents and animal herds between Sumerian towns. The Sumerians, describing those Gutians [15, lines 149-175] as “with human intelligence, but canine feelings [...] and monkey features [...]{they stole and} [...] drove the goats out of their folds, they drove the cows out of their pens [...] brigands occupied the highways [...] They, like small birds, swooped on the ground in great flocks [...]” Some nomad chieftains imitated Sumerian life and decorated themselves with a king´s title in Nippur town from 2189 BC on, the so-called Gutian kings. Lifes of those kings, however, were short: 20 kings reigned 80 years. The Sumerians, by and by, expelled them from Southern Sumer, the last, in 2112 BC.

People from the South:

The old Sumerian enemy, the Elamites, across the Persian Gulf, landed with boats in South Sumer [11, lines 251-259]: “To the South, the Elamites, like

an onrushing wave, were [...] To the South, the Elamites stepped in, slaughtering [...]" The Elamites came in organised order to systematically pilfer Sumerian towns, capture slaves, women and domestic animal herds, looting everything of value, especially copper and bronze metals, and carrying them by boat across the Gulf to Elam. Fifty years passed, and after Sumer´s recovery, the Sumerian governor Gudea of Lagash successfully sent an military expedition with a boat fleet over to Elam, repatriating looted Sumerian objects from the Elamite town of Anshan.

The tale of burying 2 towns after blasphemy and sacrilege, as God´s consequential punishment of evildoers, was preserved over millennia as biblical story of Sodom and Gomorrah. The tale sounds identical to the 4.2 kiloyear impact event. This proposal is put forward by impact specialist Bruce Masse [23] . He points out that Abraham lived in the town of Ur, and that the Sodom and Gomorrah event, with fire and hot hail-sized stone rain happened in the 99th year of Abraham´s life. His calculations arrived at "circa 2188 BC", which is "the most likely date for Sodom and Gomorrah", the 4.2 kiloyear impact date. We may add that the biblical account does not report that God made a nearby volcano to erupt. The event was of fire and of a rain with burning-hot "hail"-sized stones, coming from above. This, obviously, centuries later, caused translation difficulties, and "hail-stones" were converted into "brim"-stones {burning hot sulphur gravel}, although there is no site in the world covered with clean sulphur brim-gravel. Anticipated locations for two destroyed towns, South of the Dead Sea, are mentioned in biblical records, but those places do no have archeological merit.

One side comment should be made as well to the Biblical flood of Noah: The 4.2 kiloyear impact event should not be confused with the Sumerian river flood, quote [19]: "The archeologically attested Sumerian river flood in Shuppurak and various other Sumerian cities [...] has been radiocarbon dated to 2900 BC". Therefore, this event took place 800 years before the impact event, and left an 60 cm thick sediment stratum, positioned below the 2193 BC impact layer.

Concerning the buried Akkad town site and town features: The location is well described in [15, lines 40-56]: "Agade [...] was like {where} the Tigris flowing into the sea {Persian Gulf} [...] {and} the portals of its city opened [...]". As approximation, the figure 5 in [6], shows the limit of the marine Gulf estuary. The Sumerians came by boats down the rivers: "{Akkad} [...] made Sumer bring [...] possessions by boat."

Larger sea-going vessels "of Meluhhans, brought wares from foreign countries" over the Persian Gulf. In short distance to Akkad, lay Elam and Subir, its traders came on foot: "Elam and Subir loaded goods on packassess", arriving at Akkad, at the East bank of the Tigris. We add the proximity of the major impact crater Umm-al-Binni and can put Akkad´s location to 31°15´50.78´´N and and 47°08´51.03´´E.

As Akkad was built on top of a hill on the Eastern bank of the Tigris river, there must be river crossing stations located on the opposite river bank. The downriver station is boat station no. 2, from where boats were pulled upriver by slaves with ropes on a towpath to the crossing station no. 1. The river curve helped that boats stayed afloat in distance to the river bank. We may assume that at the moment of the impact, there were boats tied up at stations. Within seconds, boats must have filled up with burning hot pellets, immediately sinking into the mud, before all water steamed out of the river bed. There might be a chance that they remain preserved and still there to be recovered. As Akkad grew and more labour became available, the opposite riverside was fortified by a wall similar to the Akkadian town wall. The shortest distance between both walls was crossed with a river bridge, as prolongation of the river quay to the opposite side. The view of Akkad town is shown in figure 3.

To this point, we presented historical and geological evidence for the cosmic impact. Left to do is the climatological footprint analysis. This analysis will additionally prove the occurrence of the impact, will confirm the impact date and will prove the

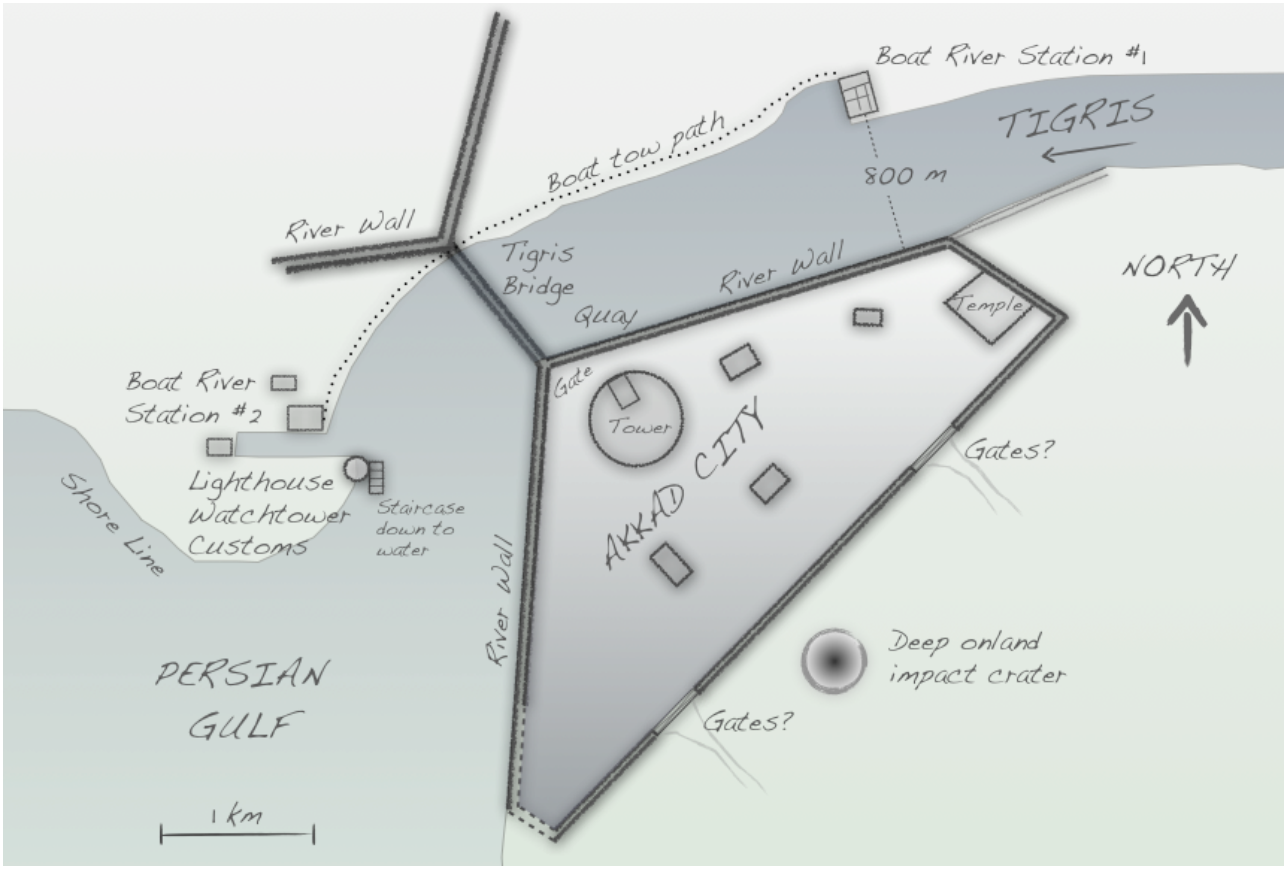

Figure 3. Akkad town.

relation between cosmic impact and immediately ensuing abrupt climate change.

Another side aspect should be mentioned: Today, two cosmic impact data bases exist and some modest cosmic impact research is carried out. All of those efforts, however, are underfunded, incomplete and disappointing. As proof may serve other hypotheses entwining the 4.2 kiloyear impact event.

3. DETAILS OF THE COSMIC CLIMATE FOOTPRINT ANALYSIS

The 4.2 kiloyear event belongs to a group of Holocene cosmic impact events, which necessarily initiate abrupt climate changes, as other impact footprints in the Holocene temperature evolution prove.

3.1. Selecting time frame and Holocene temperature evolution, and identification of mega-volcano stratospheric dimming

We decided to use a 1,000 year time frame, 2400 BC to 1400 BC. An impact time before 2400 BC in Mesopotamia is unlikely, because earlier written documents do not mention any impact events.

The Holocene temperature evolution: We will only use the most accurate data set available, which is the GISP2 ice core temperature evolution. Its resolution is the highest, because it clearly identifies, as example, recurring natural cycles, shorter than one century in length, such as the 60-year natural cycle. Data sets must show natural, recurring cycles, because those are an important feature of paleodata. We also stay away from smoothed and filtered data sets, all of them having low resolution. If the 60-year natural cycle cannot be extracted out of temperature proxies, then those proxies are of second quality, smooth out important natural cycle information and are almost worthless: As example, recent efforts of filtering hockey sticks out of spaghetti proxies [24].

We reach our first analysis picture (fig. 4) showing the GISP2 temperature evolution, 2400-1400 BC. On first impression, the 1000 year graph does not look familiar, because there is no flat part, as in the hockey stick. This 1000 year time frame shows 6

abrupt climate changes. We are already in the position to eliminate the climate change points #5 and #6, because cosmic impacts always lead first to a cooling period and not at first to a warming period. Four possible cosmic impact dates #1 to #4 remain. At the bottom of the picture, the course of the CO2-concentration is given, EPICA Dome C, a change of 4 ppm within 1000 years. Those, who relate the cause for temperature change to a CO2-concentration change should feel free to comment.

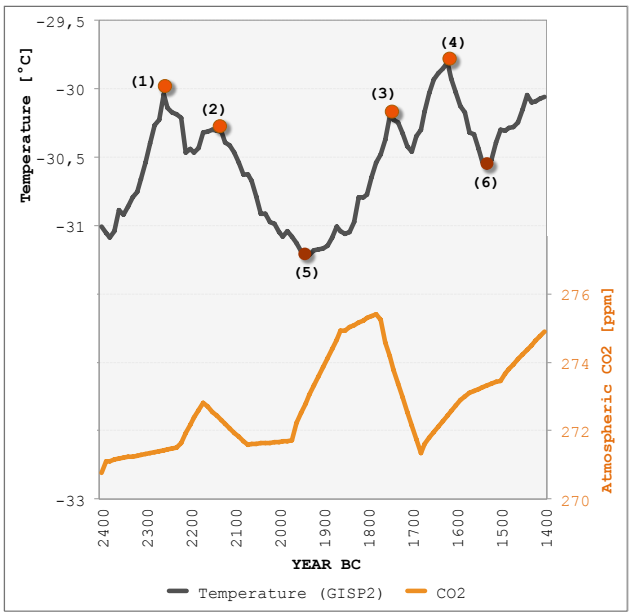

Figure 4. Six events of abrupt climate change.

Figure 5 shows prehistoric volcanoes mega-eruptions. Two eruptions are #1 and #7, which are clearly identified in ammonium analyses from GISP2 ice cores. The eruption #1 is a 2-stage event of 2 volcanoes: The Hekla4 volcano with VEI 5 (around 2300 BC) in combination with St. Helens, VEI 5 (2335 BC) . These 2 megaeruptions left a 0.5 cm ash layer as far away as Mesopotamia, immediately below the impact mud stratum [18]. The eruption #3 is the Mt. Veniaminof eruption of 1750 BC, in higher strength, VEI 6, leaving a 11x8 km diameter caldera. The #8 volcano is the Santorini-Thera volcano, of great strength, also of VEI 6.

We can see the following: A megaeruption of a volcano type blasting into the stratosphere produces stratospheric dimming, followed by a decades-long temperature decline and recovery, visible as a V-shaped temperature evolution, such as all V-s after #7, #1 and #3. The #1 is in two stages, due to participation of 2 volcanoes. The #8-eruption, Santorini-Thera was unmistakably dated in 2011, to have occurred in the year 1603 BC, and not earlier, as reckoned in older dating analyses. We can see that this eruption was not a stratospheric eruption, because no typical V-shape dimming and recovery set in. At 1603 BC, the climate cooling was, since 1628 BC, in progress for 25 years. We can therefore eliminate the Santorini-Thera eruption as a climate change cause and downgrade it to a limited regional effect in the Eastern Mediterranean. Prove is figure 5, unmistakably, the course of GISP2 is not at all affected by Santorini-Thera.

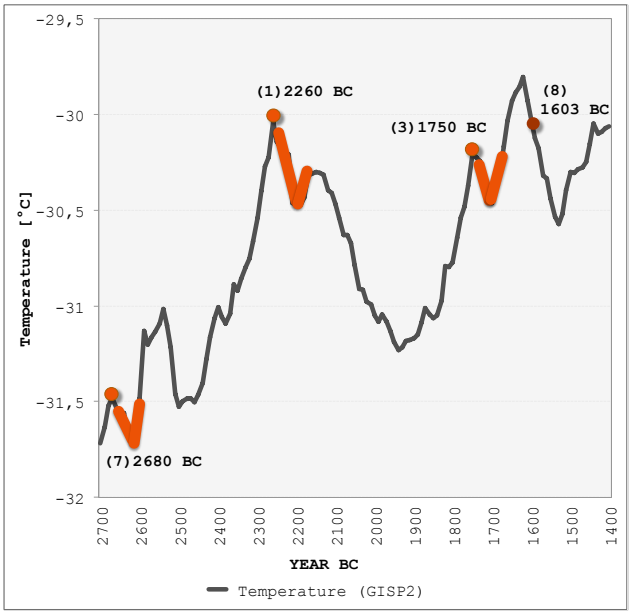

Figure 5. Volcano mega eruptions with V-type stratospheric dimming.

3.2. Selecting features of the impact footprint

Figure 6 shows 2 remaining options for cosmic impacts, at 2193 BC and 1628 BC. The younger date of the two does not concern Mesopotamia, therefore, 2193 BC is the Mesopotamian impact date.

Figure 7 shows the Holocene temperature evolution for 1000 years, taken directly out of the climate analysis [3], proven for over 20,000 years.

The picture is an original cut from the figure G in [3]. Four lines are demonstrated: 1. the GISP2 temperature, 2. the regular EOO temperature line, undisturbed by cosmic impacts, 3. the upper undisturbed temperature limit and 4. most

important, the lower temperature limit line. All EOO lines have Earth orbital origin, as explained in [3] and in [25].

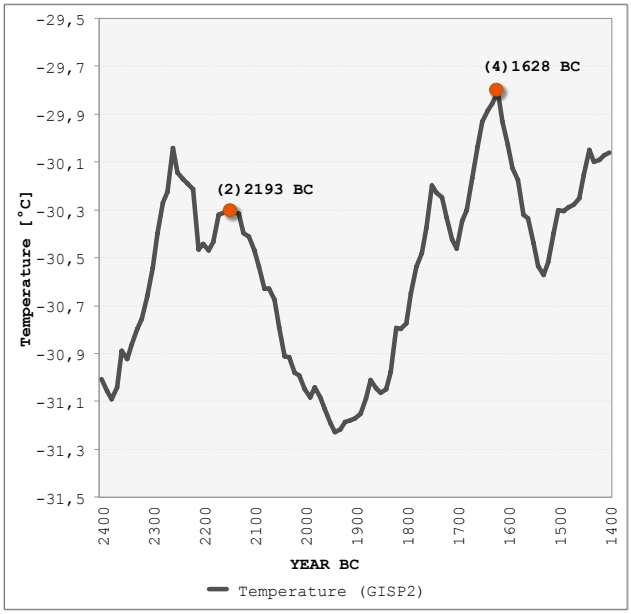

Figure 6. Two remaining cosmic impact dates.

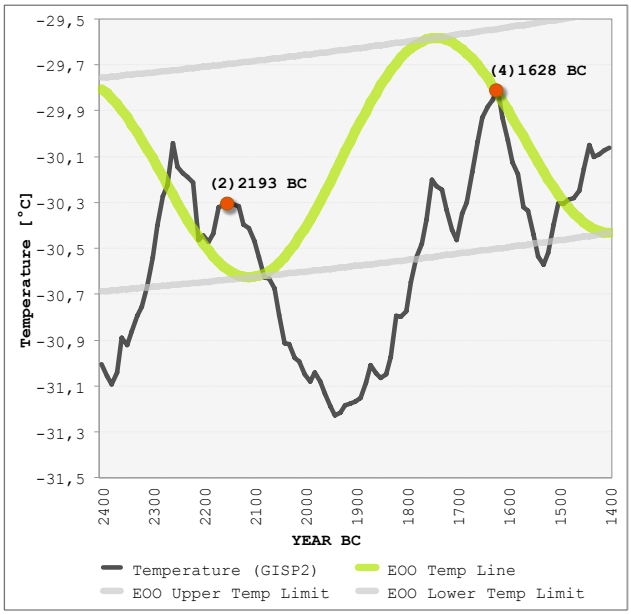

Figure 7. EOO temperature line and EOO temp limits.

3.3. The climate footprint of the cosmic impact

All large sized cosmic impacts leave their pattern or "footprint" in the GISP2 temperature record. A footprint has to meet 5 conditions to count as a true footprint of a cosmic event:

A. The impact is followed by a Z-shaped temperature evolution, with temperatures always starting downward in decline.
B. The Z-shape for decline and rebounce of GISP2 temperatures has steeper angles than those of the regular sine shaped EOO temperature line.
C. Only a cosmic impact is capable to submerge GISP2 temperatures below the EOO lower limit line, or in other words: For anytime, that temperatures go below this lower limit line, a cosmic impact must have occurred before.
D. Impact crater size and Z-footprint correlate in size. This Mesopotamian impact is of medium Z-oscillation range.
E. The regular EOO-curve has its upper and lower turning points (TPs). Only a cosmic event can shift a turning point to a lower or higher position.

A detailed paper on cosmic impact dynamics will follow, for all those with interest in Earth orbital mechanics. To mention, as an introduction, is that today´s prevailing orbital explanations are based on a simplistic curviline Earth orbital advance around the Sun, whereas the planet´s true advance is a spiral flight around its mean progressive flight line, which is kept away from the public awareness. The orbital planetary advance in its spiral shape produces the regular wave-like EOO temperature evolution, shown in [3] and [25].

The above mentioned microforcing circulation models must consequently fail in their interpretation of the Holocene, because they are based on a trivial curviline Earth orbit, leaving 5 cosmic macroforcings unconsidered.

We arrive at figure 8, showing the Z-shaped, "high-voltage" footprint. This symbol always follows cosmic impacts with crater diameters of more than 1 km.

Figure 9 demonstrates 2 cosmic impact effects: 1. The upper turning point TP is lowered. 2. The impact submerges the GISP2 temperature to lower than the EOO lower temperature limit line.

We conclude that all 5 footprint conditions are met. The literature [3] discusses additional Holocene impact events.

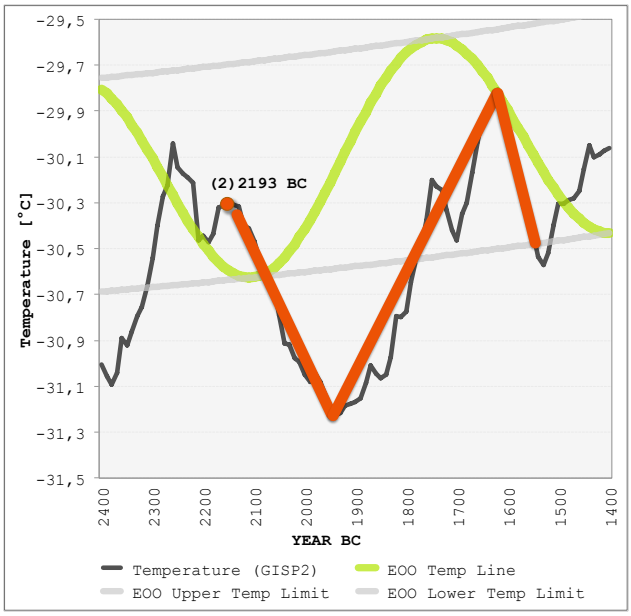

Figure 8. Cosmic impact climate change footprint - Z-symbol

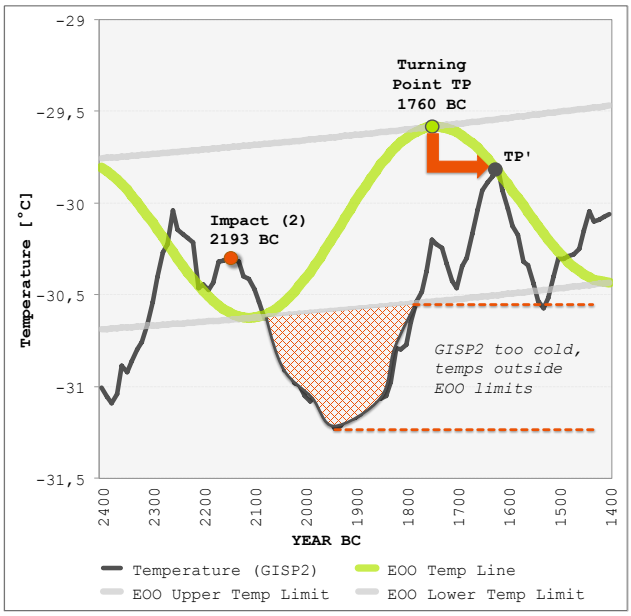

Figure 9. Cooling effect of the cosmic impact.

4. CONCLUSIONS

A. The application of the climate footprint analysis confirms the 2193 BC cosmic impact date for the 4.2 kiloyear event in Mesopotamia. All cosmic impact footprint requirements were met. GISP2 temperatures fell below the footprint bottom limit, which only occurs after a previous cosmic impact on Earth. The Z-shaped footprint symbol proves that a large cosmic impact has occurred at 2193 BC. The accuracy of the footprint analysis is high and outperforms all Holocene models on the climate market.

B. A number of historians do not comprehend the significance of the impact event and hypothesise otherwise about the end of Akkad, without ample evidence. They are also unable to locate the missing Akkadian capital. We present our results after close examination of historical documents and indicate the location of the disappeared Akkadian city. The city will soon be placed again onto the geographical world map.

C. To aridification and rapid climate change: The cosmic impact initiated the Z-shaped impact footprint with an immediately ensuing cooling and aridification period. GISP2 shows a rapid cooling at higher, Northern latitudes on the globe´s NH, which is simultaneously accompanied by severe aridification in lower global latitudes, as in Mediterranean countries, Egypt and Mesopotamia. The drought in Northern Mesopotamia, following the 4.2 kiloyear cosmic impact, wiped out rain depending dry-farming settlements. Southern Mesopotamia, with its river irrigation agriculture, did not suffer by the drought, but suffered by the direct asteroid hit. For this reason, anarchy and social chaos persisted for more than 30 years afterwards.

D. We analysed effects of volcano mega-eruptions of the greatest size, VEI 5 and 6. Those eruptions can produce a global climate change for several decades, as seen in V-shaped decadal temperature dips in GISP2. Volcanic eruptions, however, are not capable of producing long lasting centennial effects, because stratospheric dimming dissipates after a few decades. The temperature dip from 2 mega-eruptions, 2335 and 2310 BC, fully recovered over one century and did not contribute to the 4.2 kiloyear event.

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