On the Possible Correlation between the Collapse of Sialk IV and Climatological Events during the Middle–Late Holocene

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Prehistoric archaeological sites in North Central Iran suddenly disappeared around the end of the 4th millennium BCE. At Tepe Sialk, near Kashan, the last cultural period, namely Sialk IV - probably established around 3400 BCE after the last settlements of Sialk III_{6-7b} - was abandoned approximately after 500 years. The material culture of this period, known as Proto-Elamite period, is very different from the previous one, showing similarities with Susa III. This period belongs to the same horizon of Uruk III in Mesopotamia and similar evidences were discovered also at sites such as Sofalin, Shoghali, Pardis, Chaltasian, Meymanat Abad, Gholi Darvish, Maral Tepe (Uzbeki), Ghabristan, Arisman and Hissar. With the abandonment of Sialk IV, cultures affected by Uruk in Near East were simultaneously abandoned. This trend of abandonment documented in North Central Iran continued for about 500-1500 years. Paleoclimate research show that this period coincides with a cold and dry period dated approximately between 3200 and 2700 BCE. Apparently, these climatic changes threatened life more at North Central Iran than in Mesopotamia and Khuzestan, by virtue of the presence of overflowing and permanent rivers in these territories (Euphrates and Tigris above all), probably forcing the migration of people from North Central Iran to more favourable areas. The present comparative study suggests that climate changes were the main reason for the cultural collapse attested in the region.

Keywords: *North Central Iran, Sialk IV, Middle-Holocene, Late Holocene, Climate Change.*

Introduction

The ecosystem is a collection of animals and the environment, which are in a permanent interaction with each other and affect the condition of one another (Asadian, 1384: 7). Ecosystems are continuously changing. More often, a new ecosystem may appear because of such changes. A group of plants, animals and micro-organisms may be gradually substituted by other groups so that the whole collection of living beings may change (Kardavani, 1389: 241-242). The culture of human communities appears by a specific ecosystem, grows and dies out at last. The ecosystem is in close connection with Palaeoclimate, since the condition of an ecosystem depends more on the climate than morphology. Consequently, in archaeology, the climate impact on the communities is significant.

Weather system is a collection of stratosphere, hydrosphere, biosphere, lithosphere and atmosphere and their mutual effects on each other. These five spheres involve in a permanent energy transmission. Climate promotion, sensitiveness and feedback can positively or negatively affect the climate system (Mohammadi *et al.* 1395: 49). The Earth has always experienced climate changes in the long run; however, climate changes occur for a short time (Moghimi, 1391: 102-103). Gradual effects of climate change on nature do not affect human settlements the same way abrupt changes do, since humans have enough time to adapt themselves to the environment.

By the end of the last Ice Age, the Holocene began, and after 40,000 years of a challenge with coldness, more favourable conditions for a sedentary and food production lifestyle appeared. Compared to Pleistocene, the Holocene Age imposed severe

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climate changes on the Earth leading to profound changes in the evolution of human cultures. The evolving process of rural human communities in North Central Iran suddenly stopped after about 3000 years, causing an interval of the 500-1500 year. Paleoclimate research show that during late centuries of the 4th millennium BCE and early centuries of the 3rd millennium BCE (the transition from Mid to Late-Holocene). the Earth had experienced a severe cold-dry climatic event (cold-humid in Europe) climate. The abandonment of sites connected with the Sialk IV and the Uruk III cultural horizon is connected to this situation. This research aims at investigating the mentioned hypothesis based on pieces of evidence from paleoclimate research from all over the world.

Methodology

This research is based on paleoclimate findings collected during at least two decades from pollen samples, ice cores, environmental sedimentology, lakes and rivers, wind sediments, playoffs, solar radiation, etc. in the northern hemisphere of the Earth. Some Paleoclimatologists, who study on climate change in the past, have provided diagrams indicating temperature and humidity fluctuations during the Holocene Age. Despite the differences in details, they show some critical climate occurrences, with a degree of fallibility around one or two centuries. Connecting these data to the condition of Sialk IV settlements in North Central Iran and Uruk III sites may result in significant reasons why sites related to such cultural horizons were abandoned altogether.

Sialk IV Sites

The latest cultural period in southern Tepe Sialk, Kashan, is an indication of Sialk IV at the Proto-Elamite period being excavated by Ghirshman during the 1930s (Ghirshman, 1938). Stratigraphy of the site did not change while it was revised under the supervision of Malekshahmirzadi (Malekshahmirzadi, 2002; 2003; 2004; 2005; 2006; 2012). In contrast to what Ghirshman had maintained, on the basis of his stratigraphical studies, concerning a gap between cultural periods of III and IV because of the presence of a thick layer of ash (Ghirshman, 2000: 64), the revision of the excavations indicates a cultural evolution between these two periods. The existence of a layer of ash had probably been caused by industrial activities in north-western parts of southern Tepe Sialk, which had expanded during the late Sialk III and evolved in Sialk IV (Nokandeh and Fahimi, 2003: 35-36). There had been a short transitional period, in a previous stratigraphy described as Sialk $III_{6,7,7a}$ (Malekshahmirzadi, 2003: 65-69). Finally, Sialk IV, characterised by specific elements such as Bevelled-Rim Bowls, proto-Elamite tablets and *Pithoi* burials, appeared after 1500 years of hiatus. (Ghirshman, 2000: 64-75).

The Arisman site, located at 10 km from Natanz, was excavated by the joint team of Iran-German archaeologists and was classified into three separate zones I, II, III. These sections belong to different periods of time. In early 2000, an Iranian-German group started an extended research project, including archaeological studies as well as studies about mineralogy, geology, melting metals and metalworking (Chaychi, 2004: 85). Based on these excavations, Arisman had been static during Sialk III_{4-7b} and IV. Although some copper relics were found in layers at the same horizon with Sialk III_{4-7b}, most slags of metalworking, together with melting metals refer to Sialk IV. Pieces of evidence from Sialk IV (such as Bevelled-Rim Bowls and *Pithoi* burials) were discovered from C1 trenches (Chegini, *et al.* 2000; 2004). The Arisman site had been used from 3500 to 2800 BCE based on absolute dating (Pollard *et al.* 2013: 45, Tab.9).

Tepe Hissar, near Damghan, was firstly excavated during 1931-1932 by Schmidt (Schmidt, 1937) and also in 1976 by Dyson (Dyson and Howard, 1989). Moreover, in 1995 Yaghmaei decided to conduct rescue excavations (Yaghmaei, 2011) and in 2006 test trenches were conducted by Roostaei (Roostaei, 2007). According to excavations by Schmidt, this site is divided into eight phases and into three cultural periods: $I_{A,B,C}$, $II_{A,B}$ and $III_{A,B,C}$. Based on absolute dating by Dyson and Voigt, Hessar IC/IIA belongs to 3980-3865 BCE, Hissar II belongs

to 3365-3030 BCE and Hissar III belongs to 2400-2170 BCE (Voigt and Dyson, 1992: 128, Tab. 2). Pieces of evidence pertaining to Sialk IV/Proto-Elamite were obtained from the second period of the Site. It is important to stress that during excavations carried out in 1976-1977 in the Damghan Plain, four sites adjacent to Hissar were found, which contain materials related to Hissar I to III (Trinkhaus, 1989: 135-141).

Uzbeki Site in Savojbolagh, which includes five archaeological sites (Uzbeki, Yan Tepe, Maral Tepe, Jeyran Tepe, Doushan Tepe), was excavated by Majidzadeh (2010a,b). This site, that includes ten cultural periods, had been settled from the mid-6th millennium BCE to the late 4th millennium BCE. Then, after a long gap, during the second half of the second millennium BCE (during the Iron Age), it was settled once again. One of the most important findings of the late Uzbeki is the discovery of a fortification. It is shown that cultural material of Sialk IV (especially concerning Bevelled-Rim Bowls and Proto-Elamite tablets) have been found in Uzbeki VIII (or Maral Tepe III) (Majidzadeh, 2010a: 160; 2010b: 51-52).

Tepe Ghabristan, in the Qazvin Plain, was excavated by Majidzadeh during the 1970s (Majidzadeh, 1976) and was excavated once again during the 2010s (Fazeli, 2006: 79-148; Fazeli, 2007). This site revealed cultural layers pertaining to Sialk III and IV based on absolute dating, and was settled from 4215 to 2950 BCE (Schmidt *et al.* 2011: 583). A collection of wide industrial and workshop areas was found, which includes most of the findings of the excavation (Fazeli, 2006: 90). Both excavators found materials typical of the Sialk IV cultural horizon, i.e. Bevelled-Rim Bowls. Pieces of grey pottery with carved geometric decorative patterns from Tepe Ghabristan are very similar to those were found in Mesopotamia such as Neynava (Gut, 2002); however, Mesopotamian pottery is more advanced (Fazeli and Abbas Nezhad, 2006: 88-89). Tepe Ghabristan, after a gap of 1500 years, was used as a grave for Tepe Segzabad (2050-350 BCE) (Schmidt *et al.* 2011: 583) located 300 m from it (Fazeli and Naghshineh, 2006: 129).

Tepe Pardis, near Gharchak, in Varamin area was excavated by Fazeli during the 2010s and it is one of the most sites where, pottery kilns (Fazeli *et al.* 2007: 268-269), a pottery wheel (Fazeli *et al.* 2007: 421) and a water canal (Gillmore *et al.* 2009) were found. This site had been settled from the second half of the 6th millennium BCE to Sialk III6-7b (Fazeli *et al.* 2007; Vali Pour *et al.* 2009) and after a long gap which covers the whole the Bronze Age, it was used again as a necropolis during the Iron Age (Pollard *et al.* 2013: 45, Tab. 9).

Tepe Sofalin, near Pishva, in Varamin area was excavated by Hessari from 2006 to 2011 for six seasons and revealed typical cultural materials from the first and second period of proto-writing and *Pithoi* burials similar to Sialk IV. Furthermore, other cultural elements were discovered such as specific seals and diagnostic types of pottery such as string cut base, bichrome, polychrome, Banesh tray and Bevelled-Rim Bowls (Hessari, 2015a: 107-111; Hessari, 2011: 29; Hessari & Yousefi, 2009; Hessari, 2011). Proto-Elamite tablets in Tepe Sofalin are mostly about crops producing and animal husbandry. Moreover, human structures such as male and female workers are registered (Hessari, 2011: 92). Note that based on excavations by Tehrani Moghadam in 1985, this site includes graves from the Iron Age, which are destroyed today (Khalatbari, 2001a). Therefore, Sofalin had a settlement gap of 1500 years. Tepe Shoghali, near Pishva, located close to Tepe Sofalin, was excavated in the mid 2000s for two campaigns by Hessari. This site was settled during Sialk III & IV (Hessari *et al.* 2007; Hessari, 2015b). Similar to Sofalin, this site was abandoned after Sialk IV until the Iron Age. Tehrani Moghadam has excavated the graves of this site (Khalatbari, 2001b).

The site of Meymanat Abad, Robat Karim, was excavated in 2012 by Yousefi Zoshk. This site includes two Tepe: Southern and Northern Tepe. The former is dated to 3700-3400 BCE, while the latter to 3500-3000 BCE (Yousefi Zoshk, 2012). Hence, Meymanat Abad refers to Sialk III_{6-7b} and Sialk IV_1 (Yousefi Zoshk *et al.* 2016: 57). Cultural materials from Sialk IV in Meymanat Abad contains Banesh trays and Bevelled-Rim Bowls indicating the interactions between Iranians and Mesopotamians

(Yousefi Zoshk, 2015: 13). The site of Chaltasian, near Varamin, was excavated by Yousefi Zoshk in 2011. This site includes materials pertaining to Sialk III_{4-7b} and IV, the Iron Age and the historical period (Hossein Zadeh, 2011).

The site of Gholi Darvish, near Jamkaran, Qom, was excavated by Sarlak from 2003 to 2014 during eight seasons of excavations (Sarlak, 2015: 127). He showed that this site contains layers of settlements from Sialk II, IV, the Late Bronze Age and the Iron Age and no trails of life were found in 4th millennium BCE (Sarlak, 2007; 2011). According to the absolute dating, Gholi Darvish was settled once more after Sialk IV (3000 BCE) at about 2050 BCE (Pollard *et al*. 2013: 47). Hence, a settlement gap of 1000 years is observed in this site. Moreover, in Gholi Darvish, relics were found from Historical and Islamic Period. In the stratification of Gholi Darvish, numbered upward, the remnants from Sialk IV (especially Bevelled-Rim Bowls, string cut base and Proto-Elamite tablets are observed) are discovered from fifth Phase/ II_{5-1} period (Early Bronze) (Sarlak, 2011: 59; Aghili Niaki, 2011: 180) (Fig. 1 & Tab. 1).

The sites affected by the Uruk culture

The Uruk Period had been the most advanced form of socio-economic developments in Near East communities. Artists and experts of this period brought about an amazing progress in the field of arts and handicrafts (Abdi, 1999: 64). The Uruk system (Algaze, 1993) in Near East was established in the fourth millennium BCE together with the adoption of specific economic and official managing tools. Nissen (1988: 60-61) and Algaze *et al.* (2001: 200) believe that the environmental condition of the Mesopotamian region, through which two permanent rivers called Euphrates and Tigris pass, bring about the importance of drainage system for farmers. This situation caused some social complexities in Mesopotamia so that they could export their crops to adjacent regions and imported some other materials. For this purpose, within all Near East, there were built some settlements and places for commercial transactions with Mesopotamia. All these sites show forms of Uruk culture and are found from the

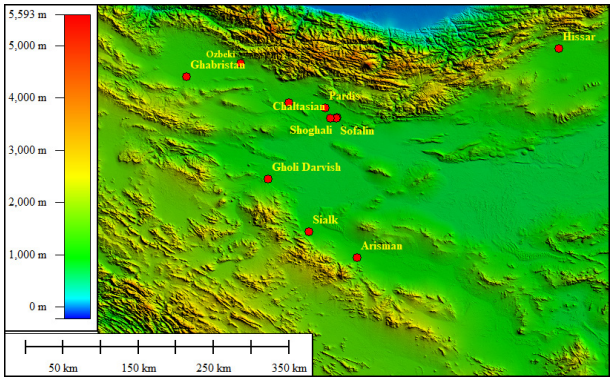


Fig. 1: *Location of Sialk III & IV at North Central Iran.*

western Mediterranean to the most eastern parts of North Central Iran.

The most indicative *leitfossil* from this period are Bevelled-Rim Bowls, attested at contexts with different function (religious, official, funerary, industrial, residential, commercial, dumping). The more distant the sites are with southern regions of Mesopotamia and Susa, the more frequent the bowls are found. There are supposed different functions for these containers during 3500 to 2700 BCE (Fig. 2) (Abdi, 1999: 66-67).

Large Urukian sites such as Arsalan Tepe/Malatya (Frangipane, 1997) in Turkey (Euphrate banks), Hadji Nebi (Stein, 1999; Schwartz and Hollander, 2008), Habuba Kabira (Strommenger *et al.* 1980), Jabal Aruda (Holland, 2006), Tell Sheikh Hassan (Böse, 1995), Hamoukar (Gibson and Maktash, 2000) in Syria (near Tigris), Tell Barak (Oates and McDonald, 2001) in north-eastern Syria (Khabour banks) and Neynava (Stronach and Lumsden, 1989). In this sites, the relics of architecture, pottery (especially Bevelled-Rim Bowls), management tools such as tablets, clay *bullae*, tokens, cylinder seals similar to cultural materials from southern Mesopotamia were discovered from the second half of the fourth millennium BCE. In Iran, findings from Godin IV (Middle and Late) and V (Early, Middle, and Late) show that this site had been settled by Mesopotamians for a long time from Mid- to Late-Uruk (Young, 1986; 1969). The cultural similarities between Susiana Plain and Fars with southern Mesopotamia are inevitable. As was mentioned, findings similar to Uruk (or as other archaeologists have suggested, identical to Susa) are abundantly

found in archaeological sites within North Central Iran. According to Stein, the relations between Mesopotamians and the native settlers of Uruk Sites (with Uruk influence) in Iran, Turkey, Northern Iraq and Syria had been in the form of commercial, competition and colonizing (Stein, 1998: 15). The most important thing regarding all Uruk sites is their sudden and simultaneous collapse. During this time (around 3000 BCE), all Uruk settlements were abandoned, and localism and regionalism were prevalent all over Mesopotamia (Mathews, 2012: 144). The abandonment of Uruk sites was probably connected with the great cooling-drought during 3200-2700 BCE, since this climate caused the reduction of crops (mainly in Mesopotamia) leading to a decrease of import and export resulting in a severe economic inflation in the region; so that the Uruk-related areas lost their ground and disappeared altogether.

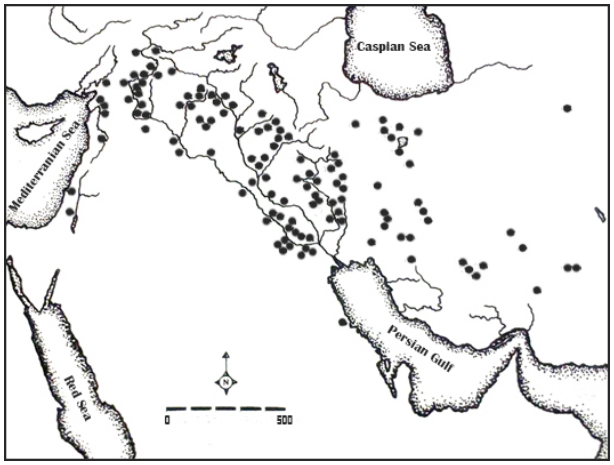


Fig. 2: *The distribution of sites containing Bevelled-Rim Bowls (Abdi, 1999: 79)*

Climate changes during the late Mid-Holocene and Late-Holocene

Paleoclimate research in western Asia show that around 3200 BCE a climate change caused a severe drought (Staubwasser and Weiss, 2006: 372). The occurrence of this climate event (called 5.2 kiloyear event) is demonstrated by data obtained from the Soreq Cave (Bar-Matthews *et al.* 1997), the Arabian Sea (Sirocko *et al.* 1993) and Kilimanjaro (Thompson *et al.* 2006) is clearly differentiated (Staubwasser and Weiss, 2006: 379). The drought of 4th millennium BCE is observed through the lack of pollen in the samples from Mirabad Lake, indicating the occurrence of a dry climate. This has caused an increase in the number of Oxygen Isotopes during 3200 BCE (Fig. 4) (Stevens *et al.* 2006; Jones *et al.* 2011: 28). The samples from Awafi Lake located in south-eastern Saudi Arabia show two great droughts in 3900 and 3200 BCE. Between 2700 and 2200 BCE we can observe the development of Middle East civilisations (Old Dynasties in Egypt; Ur to Akkad Kingdoms in Mesopotamia; Shahr-i

Table. 1: *Excavated site on the central part of North Central Iran, testifying a gap of 500-1000 years*

Iron	Bronze			Sialk IV	Sialk III$_{6-7b}$	Sialk III$_{4-5}$	Sialk III$_{1-3}$	Archaeological Site
500-1500	1500-2000	2000-2500	2500-2900	2900-3400	3400-3700	3700-4000	4000-4300	
*				*	*	*	*	Sialk
*				*	*			Arisman
*				*	*	*	*	Pardis
*				*	*			Sofalin
*				*	*	*	*	Shoghali
*				*	*	*		Chaltasian
*				*	*	*	*	Ghabristan
*				*	*	*	*	Ozbeki
				*	*			Meymanat
*	*			*	*	*	*	Gholidarvish
*	*	*		*	*	*	*	Hissar

Sukhta, Yahya, Jiroft and Shahdad in south-eastern Iran; Harappa and Mohenjo-Daro in the Indus Valley) which proves the improvement of climate conditions in that period.

According to paleoclimate research, a drought occurred in 3200-2800 BCE in Shari Playa, in the central region of Iraq (Jassim *et al.* 2007: 8). The humidity and temperature diagrams based on Greenland Ice Sheet Project 2 (GISP2), show a severe temperature reduction and humidity rise between ca. 3000 and 2800 BCE (Alley, 2004: 64). Moreover, simulation of Holocene climate changes in Sjuodjijaure Lake in Sweden shows temperature reduction and advancements of glaciers during 3100 and 2500 BCE (Rosén *et al.* 2001: 560). According to investigations on static and pollen Isotopes in Gol Hissar Lake in south-western Turkey at around 3100 BCE, the climate had become drier (Eastwood *et al.* 2007: 327), which, in fact, shows the transition from Mid- to Late-Holocene. In Baltic sea, Paleoclimate samples show a two-step temperature reduction, the first of which happened during 3000 and 2500 BCE and the second occurred between 2300 and 1300 BCE (Borzenkova *et al.* 2015: 42). The 3000-2500 BCE coldness, during Late-Holocene, was probably caused by quasi-circular changes in the Earth orbit (Borzenkova *et al.* 2015: 44). The weather temperature diagram by Xu et al. from the Paleoclimate experiments on samples from Shang Lung Van from East Asia is very similar to Alley's since it proves a cooling period during the first half of the third millennium BCE (with a peak around 2800 BCE) (Fig. 3) (Xu *et al.* 2014: 5, Fig. 6).

The social effects of the 3200–2700 BCE climate changes caused the abrupt abandonment of Uruk sites (Uruk III period) all over the vast Mesopotamia, from Zagros to Syria; because the amount of rainfall reduced leading to the reduction of rain-fed crops (Weiss, 1986: 2003). Moreover, the abandonment of watered farming in Uruk III in southern Mesopotamia is observed (Postgate, 1986). Rainfall reduction in 3200 BCE in Anatolia, which is the main source of Euphrates and Tigris (Cullen and deMenocal, 2000) shows that during this period, watered farming in southern Mesopotamia reduced because of the lack of any inventions regarding agriculture (Nutzel,

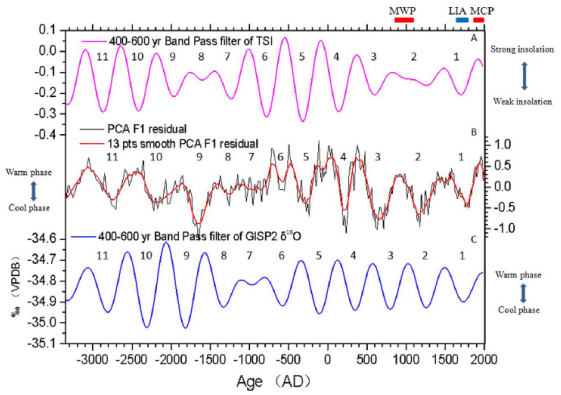


Fig. 3: Comparison of paleoclimate data from Shanw Lung Van Lake with other paleoclimate samples for the sun radiation TSI and Oxygen Isotopes in Greenland GISP2 (Xu et al. 2014: 5, Fig. 6).

2004: 122). Nissen (1988) believes that this severe drought in southern Mesopotamia led to urbanism in this region. Furthermore, the social and economic adaptation to reduced Late Uruk irrigation agro-production may also have included the collapse of its ideological and politico-economic frame, i.e. the temple. During this period, those who controlled temples in southern Mesopotamia controlled cities economically and politically and used their authority among people to legitimate the kingdom. The Mesopotamian temples during the 3rd millennium BCE became an ideological cover for the secular power (Staubwasser and Weiss, 2006: 379-380).

The Sialk IV sites in the centre of North Central Iran were abandoned during the great climate changes, and all were demolished or highly reduced (at least for about 500 years and maximally for nearly 1500 years). At the end of the fourth millennium BCE, Sialk Kashan, Arisman Natanz, Sofalin and Shoghali Pishva, Chaltasian Varamin, Pardis Gharchak, Meymanat Abad Robat Karim, Ghabristan Qazvin, Uzbeki Savojbolagh and Gholi Darvish in Qom could not resist against the cooling-drought event, and were abandoned for an extended period (1000 to 1500 years). However, the central question is whether the settlers of this region from the early 3rd millennium BCE to the second half of the second millennium BCE had died or had migrated to other regions, or their life system had changed from sedentary to nomadism. Recently, in excavations from southern Kazakhstan (near the north-western borders of Iran), in the MPS 16

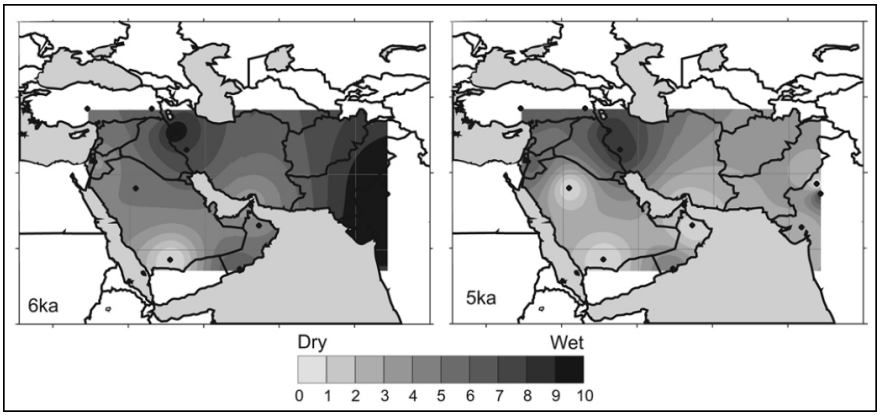


Fig. 4: *Climate condition of third and fourth millennium BCE in Southwestern Asia, indicating that the fourth millennium BCE had been more humid than the third millennium BCE (Jones et al., 2013: 31).*

site, pieces of pottery similar to Sialk III4-5 were discovered (Fig. 5) (Lyonnet *et al.* 2017: 17, 46). Although these findings relate to about 400 to 500 years before the 3200–2700 BCE drought, it may be analysed that possibly people from North Central Iran migrated to more favourable regions because of the climate hardship. Furthermore, most big cities during the Bronze Age were settled outside North Central Iran. Hence, during the late fourth millennium BCE and the early 3rd millennium BCE, those who were native to these lands migrated to surrounding regions (climate, ecosystem and more favourable facilities) and mostly they were accepted by the new civilisations of the Bronze Age. However, there remains the possibility that the ecosystem of rural areas has changed from sedentary and agriculture to nomadism and animal husbandry. Hence, it seems unbelievable to accept that these people have disappeared entirely from the timeline.



Fig. 5: *Sialk III4-5 pottery from the site MPS 16 in southern Kazakhastan (Lyonnet et al., 2012: 46).*

Conclusion

During the Holocene Age, although the average temperature had been higher compared to the Ice Age, abrupt climate change led to cultural transformations, life changes and shifts in the social settlement patterns. According to Paleoclimate research, from around 3200 to 2700 BCE, there occurred a cooling-drought period, which has probably caused the abandonment of the settlements connected with the Uruk cultural horizon. These settlements appeared with cultural materials from Uruk III culture at about 3500 BCE all over Near East, and they abruptly disappeared about 3000 BCE. However, Sialk IV in North Central Iran had existed at the same period with Uruk III, which is known as Proto-Elamite Period (3400-2900 BCE). Sites of this period such as Southern Sialk, Arisman, Sofalin, Shoghali, Pardis, Chaltasian, Meymanat Abad, Uzbeki, Ghabristan, Gholi Darvish were abandoned during the mentioned period and remained abandoned for about 1000-1500 years until the Iron Age, except for Hissar, which includes cultural layers from the Bronze Age. Gholi Darvish has got cultural layers of the Late Bronze Age and the Iron I Age. At last, cooling drought led to the abandonment of the Sialk IV site. This period lasted for about1000-1500 years, during which inhabitants of the region migrated to more favourable regions; regions where are considered as the origin of great civilisations of the Bronze Age.

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