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Ecology and subsistence at the Mesolithic and Bronze Age site of Aigyrzhal-2, Naryn valley, Kyrgyzstan

G. Motuzaite Matuzeviciute ; R. C. Preece ; S. Wang ; L. Colominas ; K. Ohnuma ; S. Kume ; A. Abdykanova ; M. K. Jones

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Abstract

River valleys in the Tien Shan Mountains of Kyrgyzstan have served as corridors for human dispersal since the Palaeolithic but little information exists on the history of human occupation in this remote and inaccessible region. Here, we report the results of a multidisciplinary study of Airgyrzhal-2, a high elevation (2005 m) site in the Naryn valley in central Kyrgyzstan. Two main occupation horizons were recognized, the earliest belonging to the Mesolithic (12th millennium cal. BC) and a later one dating from the Bronze Age (first half of the 2nd millennium cal. BC). Land snail analyses from the two horizons yielded almost identical assemblages of species of dry, open environments. Archaeobotanical data, however, revealed marked differences. The greater representation of willow/poplar (Salix/Populus) in the charcoal from the Mesolithic suggests more focused activity along the river, which might have been closer to the site at this time. The occurrence of spruce (Picea) and other species in the Bronze Age charcoal indicates exploitation of resources from more distant upland locations. The occurrence of the remains of cereals, including both grains and chaff, provides unexpected evidence for both consumption and cultivation of wheat and barley at this high elevation during the Bronze Age.

Keywords

Kyrgyzstan ; Mesolithic ; Bronze Age ; Andronovo ; Agriculture ; Wheat

1. Introduction

In recent years, grand narratives have been developed regarding the spread of innovations across Eurasia and the means of transmission for precious goods, crops and domesticated animals (Frachetti, 2012; Spengler et al., 2014a; Motuzaite Matuzeviciute et al. 2015). During the Bronze Age period, a high degree of interconnectivity between the highest mountain ranges of Eurasia, such as Tian Shan and Pamir, has been suggested. Indeed the Bronze Age has been identified as the period during which the eastern and western parts of Eurasia met via trade and human movement (e.g. Kuzmina, 2008). As Eurasia consists of a wide range of different environments, each posing different challenges requiring adaptation, more research is needed to understand how those grand narratives might work, especially in marginal environments such as high altitude mountain valleys. Here, we look at the micro-scale of the early stage of inter-mountain connectivity by investigating a site from the Mesolithic and the Bronze Age periods in a high altitude region of the Tian Shan Mountains of Kyrgyzstan. This case study analyses the economy and ecology of these populations, allowing the construction of a better understanding of the mechanisms behind those grand narratives.

The Tian Shan is a mountain massif stretching longitudinally through the portion of Eurasia separating Central Asia from China. The canyons and high altitude river valleys of the Tian Shan Mountains have been the main routes for movement of people from the Palaeolithic onwards. People occupied these valleys despite the harsh environment, resulting from the high altitude conditions and continental climate, and had to endure high speed winds that were funnelled along the narrow mountain canyons. These canyons therefore provided not only corridors for human dispersal, but also places for settlement. Little previous archaeological and palaeoenvironmental work has been undertaken in this region because of the political situation in Kyrgyzstan and the inaccessibility of the region. However, some palaeoenvironmental studies have recently been undertaken on cores from mountain lakes of Kyrgyzstan (Ricketts et al., 2001; Beer et al., 2007; Gómez-Paccard et al., 2012), providing a valuable insight into conditions in the region during the Holocene. Evidence for human occupation in the valleys of the Tian Shan Mountains was previously known from kurgan burial sites, dating from the second half of the 2nd millennium BC (Soltobaev and Moskalev, 2014) and from a Bronze Age settlement in the Kochkor valley (Tabaldiev, 2011), situated over 100 km north of the Aigyrzhal-2 site reported here. No archaeobotanical work has been undertaken at these sites and therefore little information exists on the regional economy, although such mountainous regions of Kyrgyzstan had previously been associated only with cattle breeding (Kuzmina, 2008).

The valleys of the Tian Shan Mountains, and their associated places of human activity, are therefore critical to our understanding of human dispersal and subsistence strategies in this region during the Holocene. The decision to build a new campus for the University of Central Asia in the Naryn River valley near Naryn City led to the archaeological excavations reported here that were undertaken in advance of this development. The sediments exposed during these excavations were rich in non-marine molluscs, plants seeds and wood charcoal, and also yielded vertebrate remains and archaeological material. These fossils have provided the basis for palaeoenvironmental reconstructions and for new insights into the economy of the region during the Mesolithic and Bronze Age. The site at Aigyrzhal-2 is unique, as it is the only location in the entire Tian Shan mountain range to have yielded evidence of human occupation from the Mesolithic (12th millennium BC) to the Turkic period (AD 13th century) (Soltobaev and Moskalev, 2014).

2. Study site

The Aigyrzhal-2 site (41°25′51.48″N, 75°53′9.74″N) is located at an altitude of 2005 m. a.s.l in a windy canyon stretching east–west, 2 km west of the city of Naryn in central Kyrgyzstan (Fig. 1). The predominant wind directions today are from the west and result from the Westerly Jet Stream (Yang et al., 2013) but these are affected by seasonal influences from southern monsoon currents (Cour et al., 1999). The principal factor determining the climatic regimes of the Tian Shan Mountains is the interaction between the southwestern branch of the Siberian anticyclonic circulation and cyclonic activity from the west (Aizen et al., 1997). The high elevation is the main factor influencing the air temperature distribution at a macro scale (Mathis et al., 2014). According to the Naryn climatic station data (between 1886 and 1990), the mean January and July temperatures are −16.8°C and 17.1°C respectively, the mean annual temperature is 2.7°C and the mean annual precipitation is 285.5 mm (World Climate, 2014). The vegetation in the surrounding environment is quite diverse due to the steep altitudinal gradient. The lowland vegetation (at elevations below 2000 m a.s.l.) is mainly composed of sagebrush steppe (*Artemisia*) and Chenopodiaceae, while above 2000 m a.s.l. it changes into alpine grass meadows with small shrubs. In the Naryn River valley coniferous trees only begin to grow on the steeper slopes at ~3000 m a.s.l., in areas that are difficult to access, because local residents use wood for fuel.

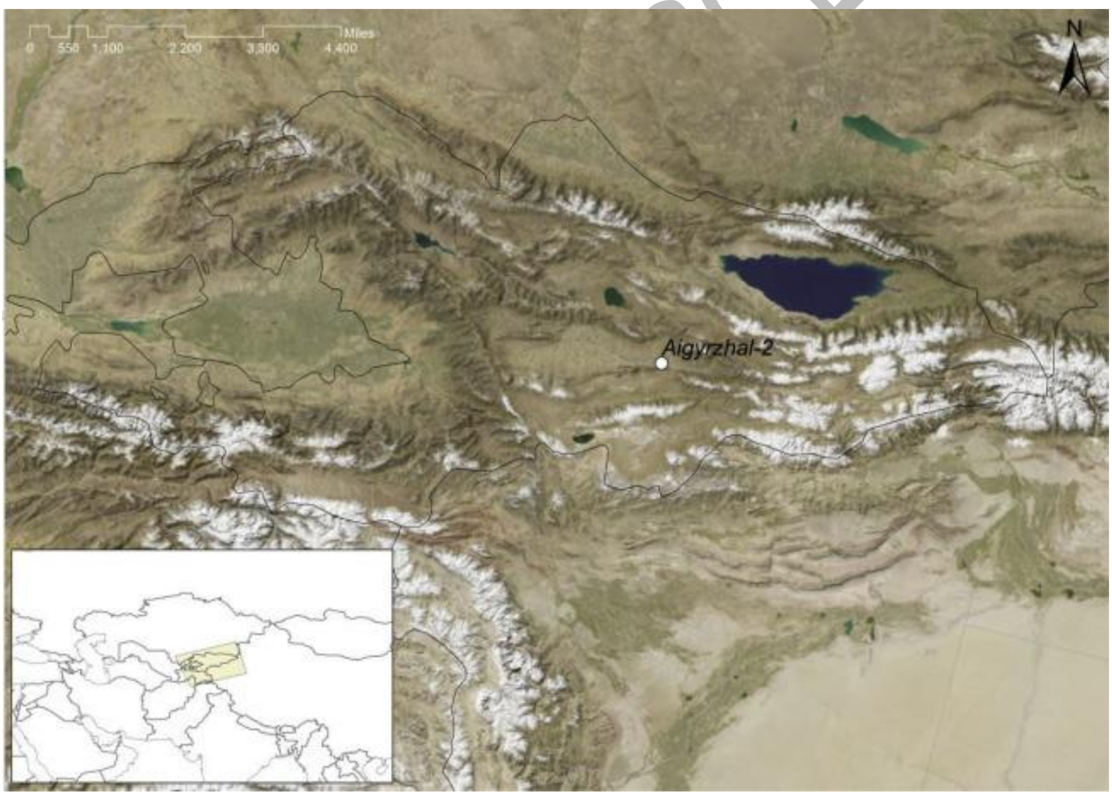

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Fig. 1. The location of the Aigyrzhal-2 site in Kyrgyzstan.

The Aigyrzhal-2 site is located about 150 m from the fast-flowing Naryn River, which originates in the Tian Shan Mountains and joins the Syr Darya to the west. The Naryn River valley forms an important boundary between mountains to the north composed largely of Palaeozoic granodioritic-granitic gneisses and mountains to the south composed of Carboniferous and Devonian metasedimentary sequences (Fig. 2), similar to those described by Mathis et al. (2014) from the Son Kul region. The terraces of the Naryn River are presently used for agriculture, mainly the cultivation of barley, millet and oats. The present floristic diversity around the site is low, and dominated by just a few plant families. However, the diversity increases rapidly towards the river, 150 m north of the site, and towards the mountain slopes150 m to the south. Closer to the river, the vegetation is dominated by Poaceae, Chenopodiaceae, Rosaceae, Asteraceae, *Salix/Populus* and *Hippophae* cf. *rhamnoides*, while higher in the mountains the dominant plant taxa consist of Poaceae, Asteraceae, *Juniperus* and *Picea*.

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Fig. 2. Views of the Aigyrzhal-2 site looking north (left) and east (right), showing its position adjacent to the Naryn River. The picture shows two geological formations that forms the river valley.

3. Archaeological excavation and sampling

The Aigyrzhal-2 site is situated on the southern bank of the Naryn River on a small oval-shaped hill in the middle of a wide canyon (Fig. 3). The hill has a long sequence of archaeological occupation horizons beginning with the Mesolithic (settlement) and Bronze Age (pits and burials) and extending through to burial sites of the Turkic period (Soltobaev and Moskalev, 2014). Excavations undertaken by Aida Abdykanova and a team of students from the American University of Central Asia in Bishkek began here in 2012 and continued through the summer of 2013. Excavations of the burials dating from the Bronze Age and later periods were conducted in parallel by a different team of archaeologists from the Krygyz National University and are not discussed further here.

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Fig. 3. Topographic map of the hill at the Aigyrzhal-2 site showing the location of the test pits and excavation area mentioned in the text (Copyright: Map data ©2007 DigitalGlobe, courtesy Google Earth).

During 2012–2013, nine tests pits were opened up on different parts of the hill to evaluate the sedimentary sequence and its archaeological record (Fig. 4). The sedimentary sequence across the hill was broadly consistent, but the Mesolithic occupation horizons and charcoal layers were only found in the pits dug on the eastern side of the hill. Test Pit 1 (Fig. 4), which covered an area of 31 m^2 excavated to a depth of ~220 cm, can therefore be taken as representative. Here, the lithology ranged from coarse cobbles to fine silts (Fig. 3), reflecting the influence of climate, the position of the Naryn River, and varying wind directions in Naryn canyon. The lower part of the section (below 219 cm depth) consisted of large cobbles up to 30 cm in diameter, indicating emplacement by high-energy water flow. The particle-size decreases upwards, giving way to gravel and sand and finally silt (loess) in the uppermost part of the sections. The sand layers within the loams indicate periods of inundation. The earliest evidence of human activity at the site was discovered in the vicinity of a hearth in a sandy loam horizon at 100–120 cm depth in Test pit 1 and in the equivalent horizon in the expanded area adjacent to it (Fig. 3). A charcoal-rich horizon, presumably of anthropogenic origin, was also discovered in a 2 m × 2 m trench (Test pit 7) opened to the north-west of the main excavation area (Fig. 3). The lithic assemblage, plant remains, and mollusc samples were collected from these two trenches, and were all shown to date from the Mesolithic and Bronze Age.

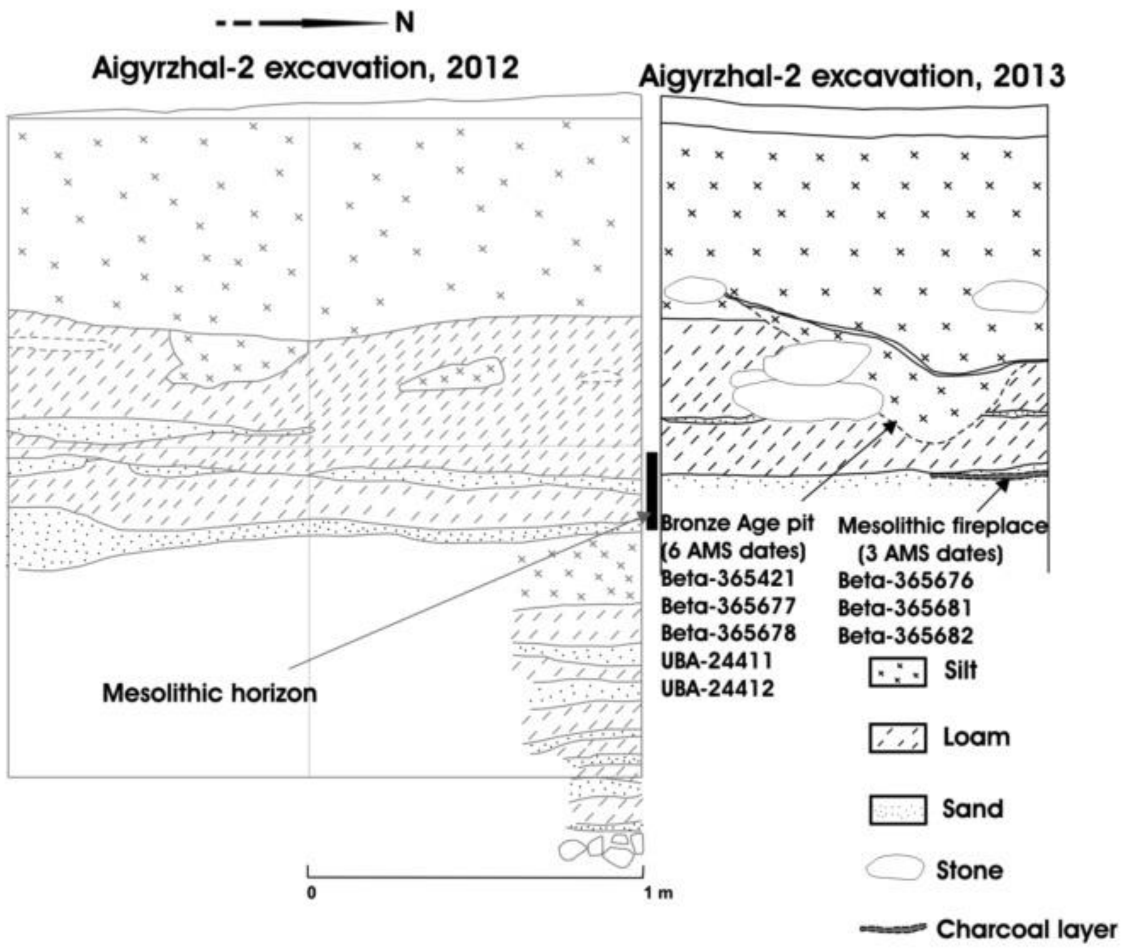

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Fig. 4. The section drawing of the Aigyrzhal-2 site of the southern wall conducted during the 2012 and 2013 excavations (excavation area No 1, see Fig. 3). The samples were collected from the Mesolithic archaeological horizons and the Bronze Age pit.

The second set of samples was obtained by flotation from sediment excavated from a Bronze Age ritual pit, dug through the silt horizon (Fig. 4). The Bronze Age pit, which was circular and covered by a cairn of stones, was buried beneath 84 cm of wind-blown loess deposits. A shard of wheeled pottery, together with remains of horse and ovicaprids were found within the pit, which appeared to have been filled during one episode of use (SOM 1, 2A,B). The discovery of wheeled pottery is significant since they hint at long distance trade and connectivity between the Namazga pottery technology in the southwestern Central Asia and the highland populations of present day Kyrgyzstan. The closest analogue of such pottery may be found in the more or less contemporaneous to Aigyrzhal-2 site of Ojakly in Turkmenistan (c. 1600 cal BC); Rouse and Cerasetti (2014) argue that this pottery is less abundant than hand-made forms, and produced by local pastoralists for trade.

4. Material and methods

4.1. Radiocarbon dating

A total of ten samples of wood charcoal, plant seeds and herbivore bones were selected for dating from the two occupation horizons (Table 1, Fig. 4).). The AMS ^{14}C dates were analysed at either the Beta Analytic laboratory in Florida, USA (Beta) or at the ^{14}C CHRONO Centre, Queen's University Belfast. The mean ^{14}C age and standard deviation of each sample was calculated using the Libby half-life (5568 y), following the conventions of Stuiver and Polach (1977). Calibration of the ^{14}C dates was undertaken using the IntCal13 calibration curve (Reimer et al., 2013).

Table 1. AMS Radiocarbon dates from Aigyrzhol-2 site.

Dated material	Context	Lab code	Conventional ^{14}C age BP	±	Calibrated age (cal. BC 95.4% hpd range) 4.2
Charcoal	Burnt layer	Beta-365680	11,730	50	11,766–11,500
Charcoal	Fireplace	Beta-365676	11,700	50	11,756–11,474
Charcoal	Fireplace	Beta-365681	11,590	50	11,599–11,351
Charcoal	Fireplace	Beta-365682	11,160	50	11,178–10,926
Bone	Pit No.1	Beta-365421	3420	50	1881–1621
Charcoal	Pit No.1	Beta-365677	3360	30	1742–1546
Charcoal	Pit No.1	Beta-365678	3350	30	1737–1534
Bone	Pit No.1	UBA-23655	3345	32	1736–1531
Wheat grain	Pit No.1	UBA-24411	3354	30	1739–1535
Wheat grain	Pit No.1	UBA-24412	3226	44	1611–1426

4.2. Seed and wood charcoal analysis

Charcoal fragments are one of the most frequent remains visible to the naked eye recovered from archaeological sites. They have unique anatomical characteristics, so that it is often possible to identify charcoal to genus and sometimes even to species level. Specimens identified to species can usually give a strong indication of an environment, or the food and fuel used by an ancient population.

In total, the 'floats' from 720 l of sediments were analysed from the Bronze Age pit and the Mesolithic horizon (fireplaces in Test pit 1 and a burnt charcoal horizon in Test pit 7) (Fig. 4) using water from the Naryn River. The sediments were collected into 12 l buckets (2 buckets per sample) and floated the same day through a 0.3 mm mesh to recover charred plant material. Each mesh containing the flotation sample was labelled and air dried. Sorting and identification of the archaeobotanical material took place at the University of Vilnius (Department of Archaeology). Scanning electron microscope (SEM) images and further identification of the plant remains was undertaken in the George Pitt-Rivers Laboratory for Bioarchaeology at the University of Cambridge. Each flotation sample was sorted individually by selecting, counting and identifying all charred seeds within the sample. The vascular tissues of trees were sorted and identified by Shuzhi Wang (Chinese Academy of Social Sciences, Beijing). Anatomical observation was carried out on fresh fractures (transverse, radial and tangential) using a reflected light microscope with dark and light fields. Identifications were carried out by comparisons with atlases of wood anatomy (Cheng et al., 1992) and with photographs of modern wood from China. The SEM was used to distinguish small-scale anatomical details and to take photographs. Wood anatomy identification was made with the help of a reference collection and the atlas by Schweingruber (1990).

4.3. Zooarchaeology (molluscs and mammals)

Land snails live in a wide range of environmental conditions and are therefore useful indicators of past environments. Molluscs were analysed from the following three contexts: two Mesolithic fireplaces (Ag: 7/17, 2/4, 7/17), dating from 11,000 BC and a Bronze Age ritual pit (Sample: Ag-2, 4–9), dating from 1800 cal. BC. The counts are not entirely standard since they are based entirely on material recovered by flotation during the extraction of charcoal and other plant macrofossils. This may have introduced some sampling bias, which explains, for example, the absence of any slug remains, and other specimens that do not float. However, standard samples of 24 l were analysed and all specimens and apices >0.5 mm were picked following Evans (1972). Representative specimens were sent to Dr Michal Horsák (Masaryk University, Brno, Czech Republic) for a second opinion.

Vertebrate remains were recovered from the Bronze Age ritual pit. One cervical vertebra of *Equus*, and two tarsals (astragalus and navicular) of an ovicaprine were recovered from the pit. The vertebrate bones were laying next to each other in a tight cluster on the top section of the pit. They were recovered during routine archaeological excavation. The sieving of removed sediments was not undertaken for small vertebrates.

4.4. Lithics

Lithics were recovered during the archaeological excavations and from the ground surface of the disturbed occupation horizons. The lithics were hand-picked from the Mesolithic archaeological horizon (in test pits 1, 5 and 7) and sieving was not performed. The analysis of the lithics was conducted at the American University of Central Asia in Bishkek and is reported in detail elsewhere (Abdykanova et al., 2014a) (SOM 3).

5. Results

5.1. Chronology

Four dates, ranging between 11,766 and 10,926 cal. BC (Table 1, Fig. 5), were obtained from the Mesolithic horizons from test pits 1 (Beta-365676: 11,700 ± 50 BP; Beta-365681:

11,590 ± 50 BP; Beta-365682: 11,160 ± 50 BP) and 7 (Beta-365680: 11,730 ± 50 BP), all based on wood charcoal from the fireplace and burnt palaeo-surface. These are the earliest dates from the Mesolithic of Kyrgyzstan.

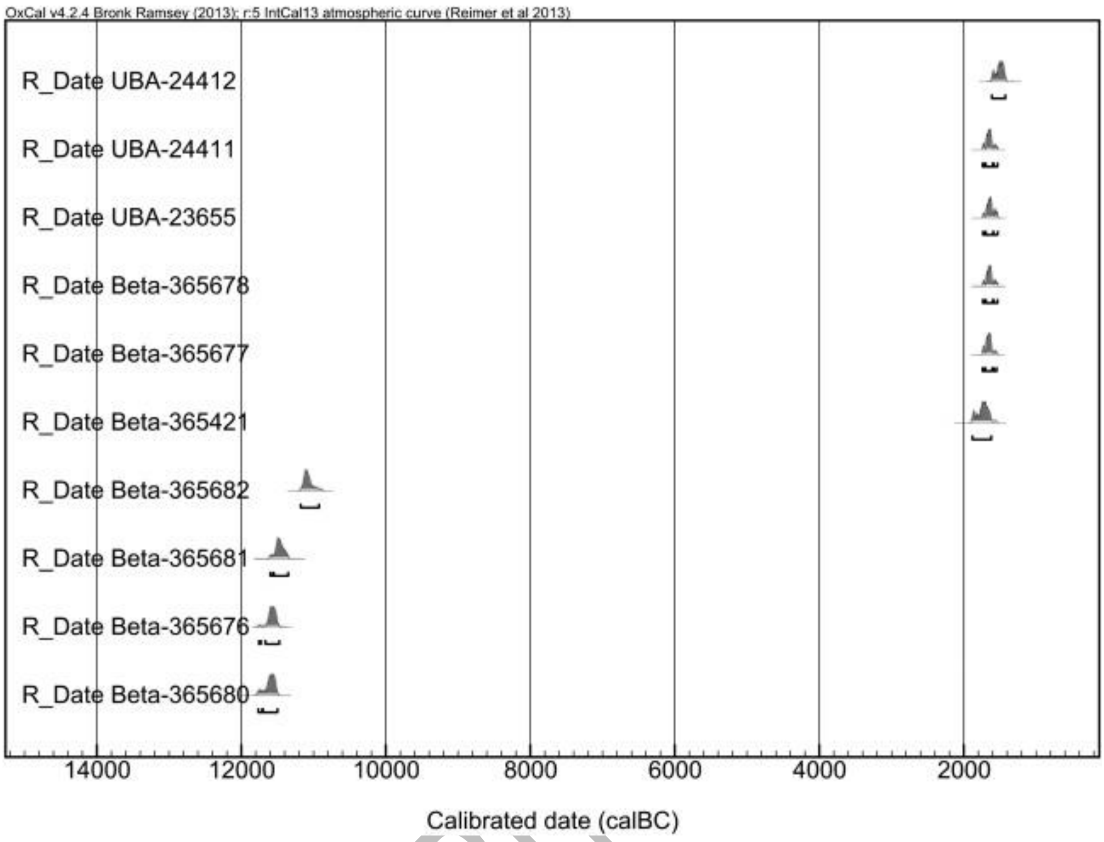

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Fig. 5. Radiocarbon ages from the two occupation horizons at the Aigyrzhal-2 site calibrated using the IntCal13 calibration curve (Reimer et al., 2013). Horizontal bars below each distribution represent the 68.2% and 95.4% highest probability density ranges (hpd) respectively.

Six dates were also obtained from the ritual pit based on wheat grains, wood charcoal and bone of an ovicaprine. All the dates fell in the Bronze Age period between 1881 and 1426 BC (Beta-365421: 3420 ± 50 B P; Beta-365677: 3360 ± 30 BP; Beta-365678: 3350 ± 30 BP; UBA-23655: 3345 ± 32 BP; UBA-24411: 3354 ± 30 BP; UBA-24412: 3226 ± 44 BP) (Table 1). The dates, especially those based on direct dating of cereal grains, are important to our understanding of the history of agriculture in Kyrgyzstan.

5.2. Wood charcoal

Twenty-five samples of charcoal, including 747 fragments greater than 2 mm, were identified. These belonged to 5 genera of trees/shrubs (*Picea*, *Sabina*, *Hippophae* cf. *rhamnoides*, *Salix/Populus*, *Betula*) and grasses (Poaceae) (Table 2, Fig. 6, SOM 4). The dominant genus amongst the charcoal was willow/poplar (*Salix/Populus*), which was found in both the Mesolithic and Bronze Age assemblages. *Salix/Populus* was especially abundant in the Mesolithic samples, which also had much higher frequency of *Hippophae* cf. *rhamnoides* (Sea buckthorn). *Salix/Populus* usually grows on river banks and in wetlands, and therefore often indicates the proximity of a river. *Hippophae* cf. *rhamnoides* is native over a wide area of Europe and Asia where natural populations occur along river valleys, and on terraces, as well as being a component of arid grasslands (Li et al., 2000). At the Aigyrzhal-2 site *Hippophae* cf. *rhamnoides* appeared to have occurred along the river, where it was exploited by the Mesolithic inhabitants.

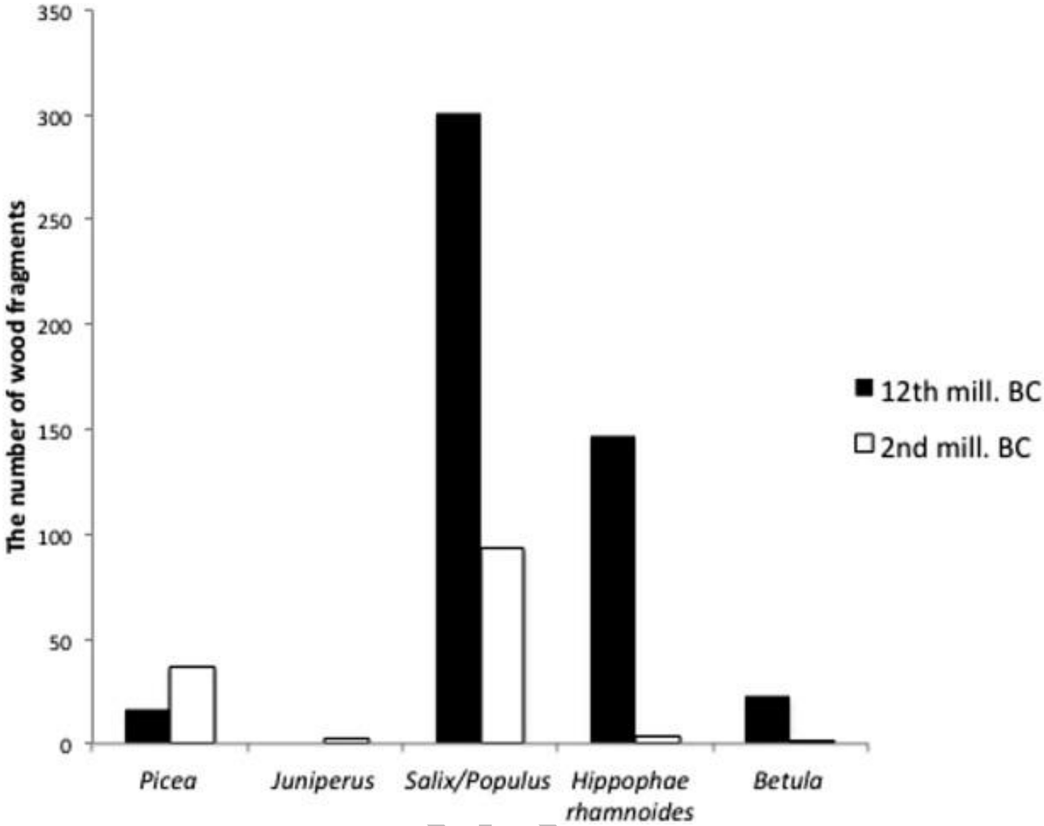

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Fig. 6. A Histogram showing the frequency and identification of wood charcoal fragments recovered from the Mesolithic occupation horizon (312l) and the Bronze Age pit (240l) from the Aigyrzhal-2 site. The charcoals greater than 2 mm were identified.

Betula (birch) was also abundant in the Mesolithic samples. *Betula* is usually a lowland genus and at the Aigyrzhal-2 site it probably grew mainly along the mountain river. *Picea* (spruce) was much more frequent in the Bronze Age samples. Spruce is widely distributed in high-latitude boreal coniferous forests, and in mid-latitude subalpine coniferous forests (Cui et al., 1997) but Schrenk's Spruce (*Picea schrenkiana*), a native of the Tian Shan Mountains, grows mainly on the shaded slopes of the mountains. It was not possible to identify the species of spruce represented in the charcoal assemblage.

One fragment of *Juniperus* (Juniper) was recovered from a Bronze Age sample but it was not possible to identify it to species. Presently, *Juniperus pseudosabina* (Turkestan Juniper) grows in the area. This species is native to the mountains of Central Asia in northern Pakistan, northeastern Afghanistan, Tajikistan, Kyrgyzstan, eastern Kazakhstan, western China, western Mongolia, and south-central Russia. It typically grows at altitudes of 2000–4100 m (Adams, 2004).

Table 2. Charcoal recovered from various contexts at the Aigyrzhol-2 site showing the number of identifiable charcoal fragments (>2 mm diameter) in 24 l of sediment.

Sample code	*Picea*	*Juniperus*	*Salix/Populus*	*Hippophae* cf. *rhamnoides*	*Betula*	Poaceae
2nd Millennium BC						
Ag.-2 1-1	18	2	7	1		
Ag.-2 1-3	4		6			
Ag.-2 1-6	2		7			
Ag.-2 1-7	7		3			
Ag.-2 1-7	2		2			
Ag.-2 2-2			6			
Ag.-2 4-9	3		3			
Ag.-2 4-11	1		8			
Ag.-2 4-18			6			
Ag.-2 7-15			45	3	1	
12th Millennium BC						
Ag.-2 7-14				56		
Ag.-2 7-17			7	21		
Ag.-2 7-19			2	29	5	
Ag.-2 7-20	2		60	1	1	
Ag.-2 7-21			67	31	3	
Ag.-2 8-13	1		3	2	1	
Ag.-2 8-22			6			5
Ag.-2 5-10			76			
Ag.-2 7-16			40	7	10	
Ag.-2 2-4			16			
Ag.-2 2-5	6		18			
Ag.-2 3-8	1		1		1	

Sample code	*Picea*	*Juniperus*	*Salix/Populus*	*Hippophae* cf. *rhamnoides*	*Betula*	Poaceae
Ag.-2 3-8	6		5		2	

5.3. Seed and fruit analysis

The archaeobotanical material consists of cereal remains and chaff as well as various wild plants species (Table 3). Wheat grains, barley grains and both wheat and barley rachis fragments were identified from the flotation samples. Eleven grains of wheat and 26 rachis internodes were identified, as well as three grains of barley and four barley rachis internodes were identified. The remaining cereal grains (12 in total) were attributed to *Cerealia* type due to the limitations of their preservation.

Table 3. The list of plant species from various contexts at the Aigyrzhal-2 site (each sample was 24 l). All the seeds are carbonized, except *Lithospermum arvense*, containing mineralized seed remains.

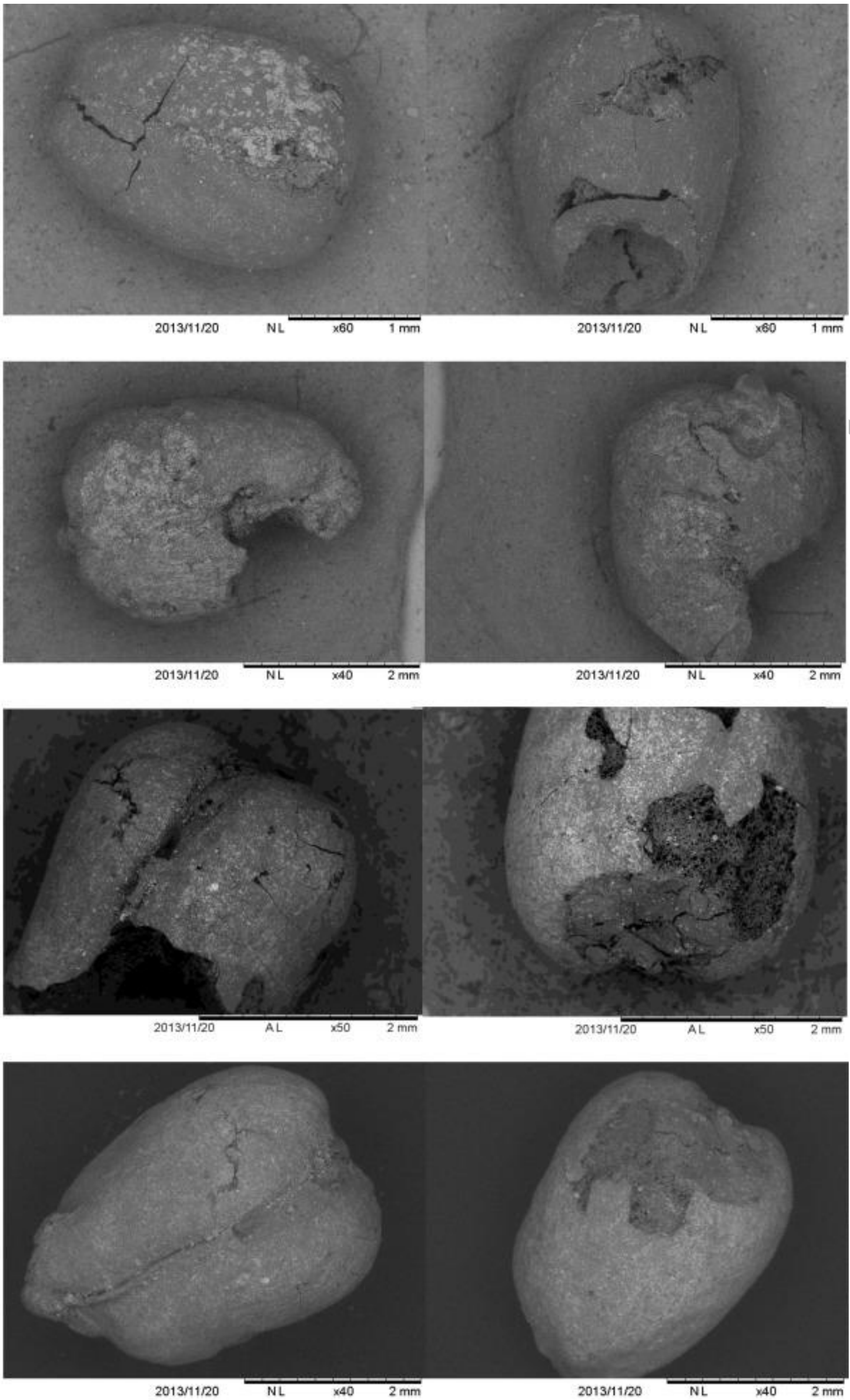
Flotation sample	Context	*Triticum (grains)*	*Triticum cf. aestivum (rachis)*	*Hordeum* (grains)	*Hordeum* (rachis)	Cerealia	*Lithospermum arvense*	*Stipa/Bromus*	*Alchemilla*	*Daphne*	*Hordeum*	Brassicaceae	*Carex*	*Arabidopsis arenosa*	Chenopodiaceae	*Oxalis*	Un-identified seeds
1/1 A	BA Pit		6			1	10										1
1:1 B	BA Pit	3					5	1	1								1
1:3	BA Pit						10										
2:2, 5	BA Pit			1	1	3		1				2					
1:7	BA Pit	1															
1:6 A	BA Pit	1			1												
1:6 B	BA Pit		6			1		1				1	1	1	1		2

Flotation sample	**Context**	***Triticum* (grains)**	***Triticum cf. aestivum* (rachis)**	***Hordeum* (grains)**	***Hordeum* (rachis)**	**Cerealia**	***Lithospermum arvense***	***Stipa/Bromus***	***Alchemila***	***Daphne***	***Hordeum***	**Brassicaceae**	***Carex***	***Arabidopsis arenosa***	**Chenopodiaceae**	***Oxalis***	**Un-identified seeds**
7:15	BA Pit					2	10										
4:9, 11	BA Pit	6	14	2	2	4		3			3					1	2
2:4	BA Pit					1	18			1							
7:19	Mesolithic fireplace																1
7:17,16, 14; 8:22	Mesolithic fireplace																
2:1	Mesolithic fireplace											1					

The wheat in the archaeobotanical assemblage of the Aigyrzhal-2 site comprises more than one morphological type, and may be grouped according to the grain shape and size as well as rachis internode shape and sizes (Figs. 3–4). The sample size is not big enough to ascertain whether those differences in grain and rachis size and shape reflect the position on the wheat ear, reflect the variability of cereal within the same taxa, or indicate different wheat species. Therefore, we list our observations below describing different grain and rachis internode groups without identifying cereal to species.

The first group of wheat grains is plump and semi-spherical in shape and relatively small (Fig. 7a). The ventral furrow is very narrow and shallow. The embryo notch is shallow and the tip is blunt. The grains are a minimum of 2.3 mm in length and 1.8 mm in breath. A similar form of grains was observed at the other archaeobotanically investigated sites in Afghanistan, Tadjikistan, Turkmenistan and Kazakhstan, such as Shortugai, Sarazm, Tuzusai, Tasbas and Begash (Frachetti et al., 2010; Spengler and Willcox, 2013; Spengler et al., 2013, 2014a,b,c; Doumani et al., 2015). Due to their spherical shape and relatively small size, some archaeobotanists refer to these wheat varieties as *T. aestivum* subsp. *compactum* or *T. aestivum sphaerococcum* (Spengler et al., 2014a). In western Eurasia, spherical wheat forms have been called *T. compactum*, *T. antiquorum* or *T. parvicoccum* (Kislev, 1979; Burkitt, 2012).

a)



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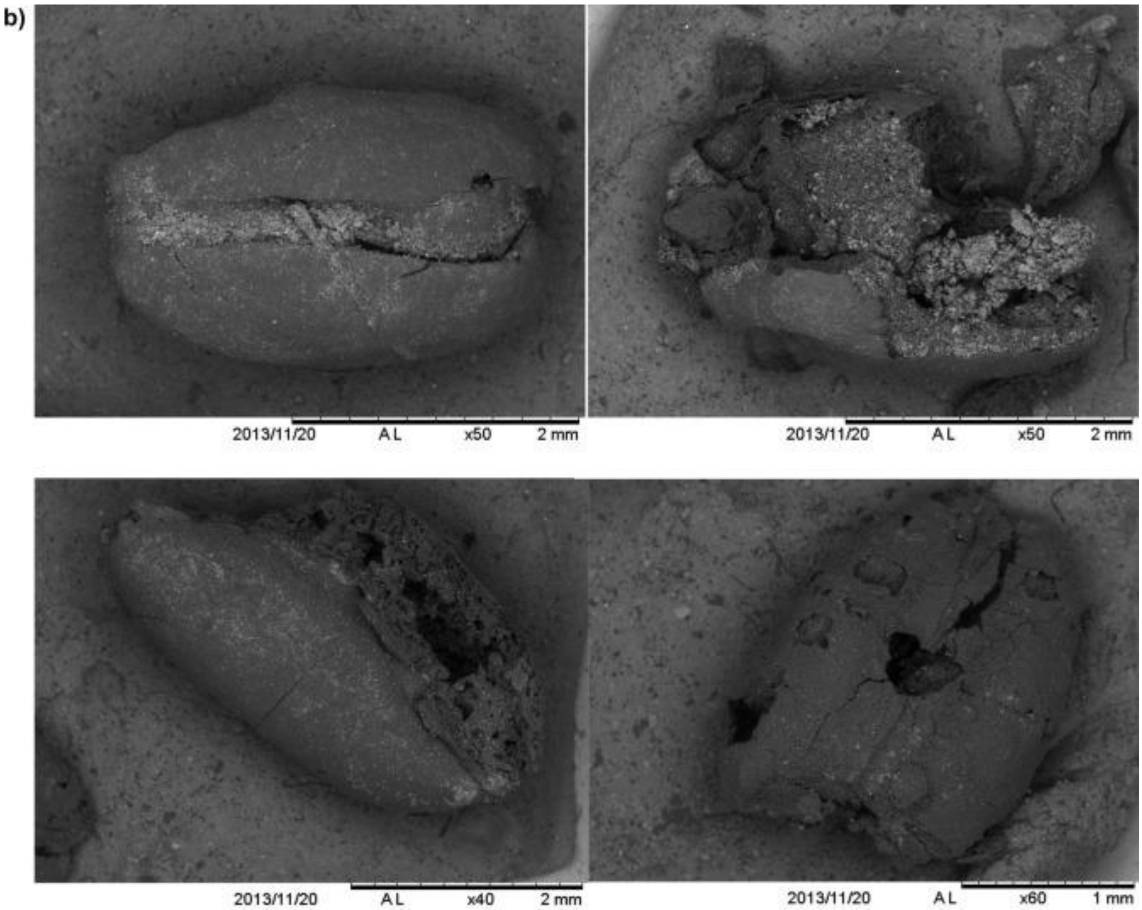

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Fig. 7. The range of caryopses lengths and breaths in wheat from the Aigyrzhal-2 site. The images present the dorsal and ventral views of the grains.

Wheat grains in the other group have a lax-eared form. The grains are elongated and narrow (Fig. 7b). The length of the grain is normally twice the breath. The ventral furrow is deep and distinct. The embryo notch is deep and clearly expressed, while the dorsal ridge is quite low.

Cereal grains, however, are not the definitive diagnostic for cereal identification to species, especially for separation a tetraploid and hexaploid free-threshing wheats, as their grain shapes overlap considerably (Jacomet and Schlichtherle, 1984; Zohary and Hopf, 2000). Therefore the spikelet bases found at the Aigyrzhal-2 site could lead to greater definition. Following the criteria described by Hillman (2001), Hillman et al. (1996), Renfrew (1973), and Jacomet (2006), we can group the spikelet basis into 3 groups.

Wheat rachis internodes in the first group form straight-sided trapezia, narrowing below the node. The thickenings (swellings) or rounded lumps under the glume base are very distinct. Pieces of glumes often survived attached on the glume base. In transverse section the rachis edge is rounded. The rachises also do not have striations or dorsal veins (also called longitudinal markings), a trait characteristic of hexaploid wheat varieties (Hillman et al., 1996). Some of the rachises also have a quite distinct upper scar (Fig. 8). This type of rachis internode is more common in the tetraploid rather than hexaploid wheat varieties.

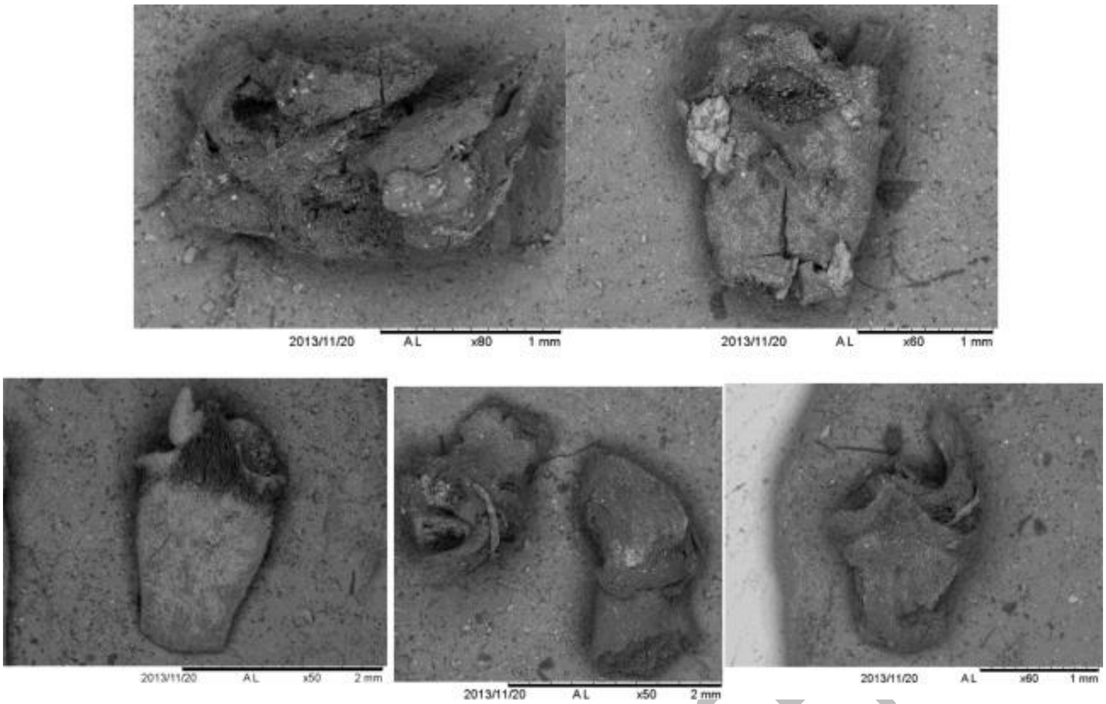

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Fig. 8. First group of free-threshing wheat rachis segments with rounded lumps under the glume base from the Aigyrhzal-2 site.

Wheat rachis internodes in the second group are curved (shield-shaped) with a maximum width just above the middle of the rachis segment (upper third of the internode) (Fig. 9). At the positions of glume emergence there are no lumps, only a small ridge where the glumes were attached, but all the glumes were broken off and did not survive charring. In transverse section the rachis edge is attenuated, also a characteristic feature of hexaploid wheat.

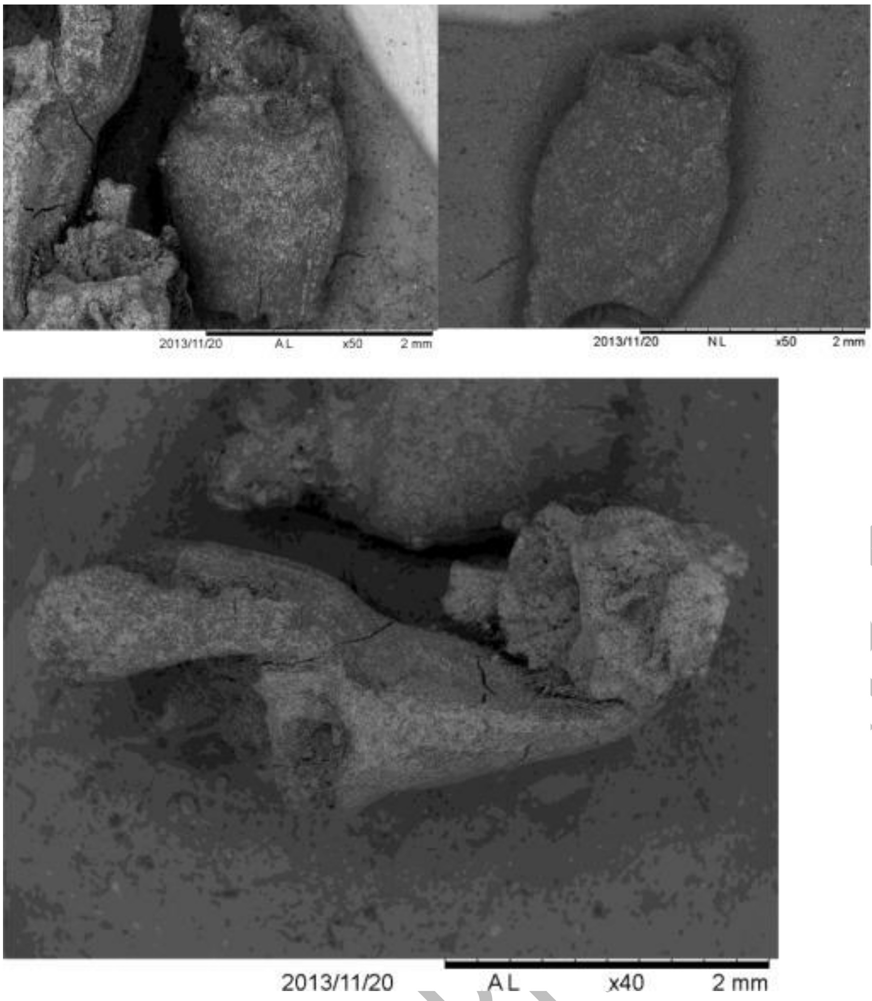

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Fig. 9. Second group of free-threshing wheat rachis segments from the Aigyrzhal-2 site, represented by the shield-shaped ones with no rounded lumps under the glume base.

Wheat rachis segments in the third group bear very distinct dorsal veins or longitudinal lines. This feature has provided the most reliable criterion for the separation hexaploid from tetraploid wheat (Hillman et al., 1996), indicating their possible attributions to hexaploid wheat varieties. Hillman et al. (2001) note that in compact/dense-eared forms of wheat, those lines are more conspicuous. The shape of the internode itself looks more like the first group variety that form straight-sided trapezia, narrowing below the node, more typical of tetraploid wheats (Fig. 10).

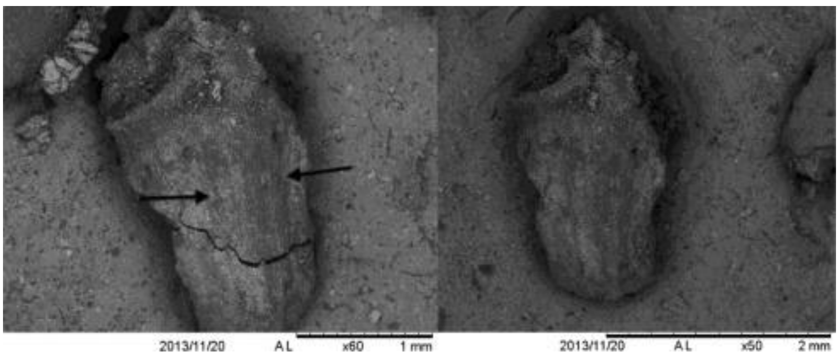

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Fig. 10. The third group of rachis internodes at Aigyrzhal-2 site are of the free-threshing wheats, characterised by the clearly seen dorsal veins (middle and right).

Barley was also observed within the assemblage, mainly in the form of rachis internodes (Fig. 11). A few grains contain features characteristic of barley, but the preservation is generally too poor to distinguish whether they are naked or hulled.

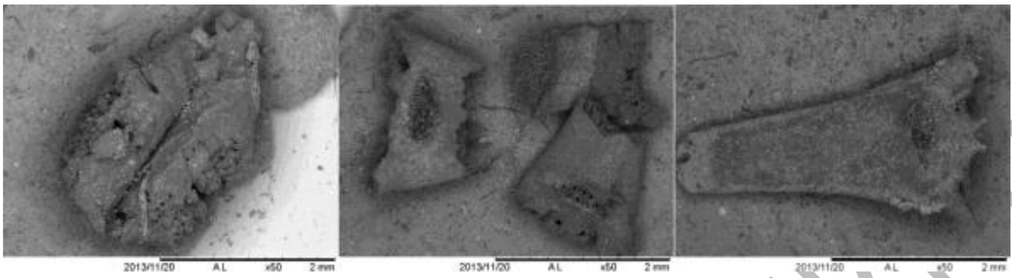

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Fig. 11. Grain of barley (*Hordeum*) (left) and barley rachis internodes (middle and right).

The wild plant taxa found in the archaeobotanical Bronze Age assemblage (Table 3) indicate a rather dry and grassy landscape. The assemblage is dominated by *Lithospermum arvense* together with *Hordeum*, *Stipa* and *Bromus*. The other identified taxa, such as *Daphne* and *Arabidopsis arenosa* are well adapted to growth in mountainous regions. The remaining plant taxa, including *Carex*, Brassicaceae or Chenopodiaceae, could have grown along the disturbed banks of the meandering river. Plants remains were virtually absent in the Mesolithic horizons, precluding further discussion.

5.4. Lithic collection

The lithic artifacts recovered from the Mesolithic layers (pit 1, pit 5 and pit 7) including narrow-face cores (n = 3), bifrontal parallel cores (n = 3) fragments of the cores (n = 3), core-like debris (n = 5), flakes (n = 133), fragments of flakes (n = 12), technical spalls (n = 31), blade, bladelets (n = 4), fragments of bladelets (n = 10), microblades (n = 8), fragments of microblades (n = 34), chipped pebble (n = 41) and debris (n = 6). Eighteen tools were recovered, classified into following groups: end scrapers (n = 3), angular scraper (n = 1), atypical scraper (n = 1), trapeze (n = 1), retouched flake (n = 3), retouched blade (n = 1), retouched bladelets (n = 4), retouched microblades (n = 3), splintered piece (n = 2).

The lithic industry of the site is characterized as microlithic and is typical of the earliest stage of the Mesolithic. The industry is based on a microblade technology of reduction based on the pressure technique and includes one edge-retouched bladelets and microblades, splintered pieces and small scrapers (e.g. Islamov, 1980). The retouch technique is characterized by an abrupt or semi-abrupt parallel retouch, which is located on the dorsal face of a microblade. Technologically and typologically the lithic complex of the Aigyrzhal-2 site is similar to those of other Mesolithic sites, such as Alamyshyk and Uch-Chat (Abdykanova et al., 2014b). Some analogous flint tool-making technology was found at Obishir caves 1–5 in another early Mesolithic complex in Kyrgyzstan, where the flint-making technique was represented by parallel flat cores, the presence of small scrapers and trapeze arrow points (Korobkova, 1999). Aigyrzhal-2 is both the largest and the earliest Mesolithic site known from Kyrgyzstan and the entire Tian Shan region (Abdykanova et al., 2014a).

5.5. Analysis of vertebrate remains

Vertebrate remains recovered from the Bronze Age ritual pit included one cervical vertebra of *Equus*, and two tarsals (astragalus and navicular) of an ovicaprine. Pits with charcoal and the remains of ovicaprid and horse bones (usually lower limbs) have often been recovered both within or adjacent to the burials of the Bronze Age communities and have been linked with ritual activities (Bernshtam, 1952; Anthony, 2007; Kuzmina, 2008; Outram et al., 2011; Soltobaev and Moskalev, 2014).

5.6. Land snail analysis

The mollusc samples were extremely fossiliferous, but only six species were recovered (Table 4). Apart from the two specimens of *Galba truncatula*, recovered from the Bronze Age ritual pit, the assemblages were composed entirely of terrestrial species. *Galba truncatula* is amphibious and can live out of water on damp muddy surfaces. *Succinella oblonga*, which was present in all three samples, also lives in similar damp environments. The occurrence of *Euconulus* cf. *fulvus* suggests moist conditions with some vegetation. The remaining species, which completely dominate the assemblages, indicate dry, open habitats. The most abundant of these in each sample was *Pupilla turcmenica*, a poorly known species recorded from screes and in other dry habitats at various places in Central Asia (Schileyko, 1984; Pokryszko et al., 2009; Sysoev and Schileyko, 2009). A second species of *Pupilla* with less rounded whorls and a smoother shell was also present in each sample but in much lower numbers. On the advice of Dr Michal Horsák, who has recently undertaken a detailed phylogenetic study of this genus (Nekola et al., 2014), these have been tentatively referred to *Pupilla pratensis*. However, the shells of these differ from reference material of the species from Scandinavia, so there remains some uncertainty about this identification until modern specimens from this locality can also be studied using molecular techniques. The final species common in all samples was *Vallonia asiatica* (Fig. 12), another species typical of dry, open conditions. This species has been found in Armenia and in mountain regions of Central Asia (Gerber, 1996; Sysoev and Schileyko, 2009).

Table 4. Mollusca from various contexts at the Aigyrzhol-2 site.

	Mesolithic fireplace 1; c. 11,000 B C	**Mesolithic burnt layer c. 11,000 B C**	**Bronze Age ritual pit, 1800–1500 cal. BC**
	F7/17	**Ag-2, 2-4**	**Ag-2, 4-9**
Aigyrzhal-2: Mollusca			
Volume analysed (l)	24	24	24
Galba truncatula (Müller)	–	–	2

	Mesolithic fireplace 1; c. 11,000 B C	Mesolithic burnt layer c. 11,000 B C	Bronze Age ritual pit, 1800–1500 cal. BC
	F7/17	Ag-2, 2-4	Ag-2, 4-9
cf. *Succinella oblonga* (Draparnaud)	1	2	15
Pupilla cf. *pratensis* (Clessin)	3	243	16
Pupilla turcmenica (Boettger)	404	971	305
Vallonia asiatica (Nevill)	39	208	183
Euconulus cf. *fulvus* (Müller)	2	36	7

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Fig. 12. SEM images of *Vallonia asiatica* from the site at Aigyrzhal-2.

6. Discussion and conclusions

Two sets of samples shown by radiocarbon dating as belonging to the Mesolithic and the Bronze Age were investigated for wood charcoal, plant seeds, lithics and land snails. The oldest archaeology from the Aigyrzhol-2 site is represented by a lithic technology that includes the manufacture of microliths, a feature of early Mesolithic assemblages in the region (Ranov, 1967; Ranov and Kadyrov, 1969; Ranov and Yunusaliev, 1969; Islamov, 1980;Abdykanova et al., 2014a,b). However, the associated dates, which fall in 12th millennium cal. BC, were unexpectedly early, although few of the previously investigated Mesolithic sites in the region have furnished detailed radiocarbon chronologies. The dates from the Aigyrzhol-2 site represent the earliest known from any Mesolithic site in the entire Tian Shan region.

Despite the large time interval between the Mesolithic (12th millennium cal. BC) and Bronze Age (2nd millennium cal. BC), it is clear that similar species of land snails and trees were present in the Naryn valley, suggesting broadly similar environmental conditions. However, it appears that different parts of the landscape were exploited during these different periods for fuel. The dominance of spruce charcoal in the Bronze Age samples indicate that the higher mountain slopes were exploited, whereas during the Mesolithic activity seems to have been focused along the river banks, as reflected by the greater representation of riparian taxa (e.g. *Salix/Populus*). The assemblage of tree species used for fire during the Mesolithic period supports our geoarchaeological evaluation of the site, showing that the meandering Naryn River may have encroached rather closer to the Aigyrzhal-2 site during the Mesolithic period. The site was consequently periodically flooded, as reflected by sand lenses within the loams.

The Bronze Age pit analysed in this paper had been cut into silts, sands and loams and almost reached the Mesolithic horizon. Almost 9000 years separates the Mesolithic and Bronze Age and it is interesting to consider why such an extensive hiatus should have occurred between the two occupations (Fig. 4). The mountain slope vegetation during the moderate climate (less continental) probably stabilised the soil and prevented colluvial and aeolian sediment accumulation at the Aigyrzhal-2 site during this 9000 year period. By the Bronze Age, the Naryn River had shifted its course away from the site, leading people to collect fuel for fire from the higher slopes of the Tian Shan Mountains away from the river. No evidence of hearths is known from the Aigyrzhal-2 site that date from the Bronze Age period and the charcoal assemblages containing *Picea* and *Sabina* suggest that the material from the pit was probably brought from the higher slopes of the hills. Wild *Daphne* and *Arabidopsis arenosa* found in archaeobotanical assemblages also suggest exploitation of the higher mountain slopes. As the archaeobotanical data pinpoints the varying sources of fuel used during the episodes of Mesolithic and Bronze Age fires, various environmental niches, including riverbeds and the high mountain terrenes, were exploited in both Mesolithic and Bronze Age periods. This can be seen from the location of the Mesolithic sites in the caves of the mountain terrenes; while during the Bronze Age highland mobility is a common strategy found among pastoralists throughout the Inner Asian Mountain Corridor, the evidence of which has been also supported by the archaeobotanical data (e.g. Frachetti and Mar'yashev, 2007; Frachetti, 2008; Spengler et al., 2013).

The land snail fauna of this region appears to have been remarkably stable since the late-glacial and the assemblages show no real differences. Dry, open conditions appear to have persisted during the 12th and the 2nd millennia BC. Our data are consistent with results obtained from Son Kul Lake, situated 65 km north-west of the Naryn region, implying a continental and arid climate before 6350 cal BC and after 2500 cal BC (Lauterbach et al., 2013, 2014; Mathis et al., 2014). As no environmental and archaeological record exists from the period between the 12th and the 2nd millennia BC we cannot be certain about the environmental stability, but limited ecological changes during the 12th mill. BC and the 2nd mill. BC show that populations with different economic strategies adapted to the local microenvironment.

The subsistence strategies practiced by the local Mesolithic and Bronze Age populations differed considerably. The flint tools manufactured during the Mesolithic were probably used for hunting small animals that existed locally in a dry, open environment severely affected by rather extreme continental conditions. During the Bronze Age, the highland valleys of the Tian Shan were occupied by pastoralist groups that are thought to have arrived in Kyrgyzstan from the Semirechye region in Kazakhstan (Soltobaev and Moskalev, 2014). Those pastoral Bronze Age communities performed cremation burial practices and richly decorated pots with comb ornament and rounded shoulder (Koryakova and Epimakhov, 2007). During the Bronze Age at Aigyrzhal-2, remains of domestic animals, such as horse and ovicaprines, together with cereal crops and their chaff (wheat and barley) provide clear evidence of human involvement in agricultural activities. The presence of cereal grains and their chaff in ritual contexts, together with remains of economically important animals (sheep/goat and horse) shows that cereal cultivation formed an important part of the subsistence of this Tian Shan population. The unexpected discovery of agricultural activity at such a high attitude, where conditions must have been particularly difficult, is noteworthy. This newly recognised agro-pastoralism economy during the Bronze Age in the Tian Shan mountain valleys of Kyrgyzstan indicates considerable human adaptability to harsh climate conditions, and supports the hypothesis that these valleys were the corridors allowing the spread of new technologies (e.g. cereal cultivation) across Eurasia, so connecting the south-western Central Asia with regions to the east of the Inner Asian Mountain Corridor.

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Appendix A. Supplementary data

The following are the supplementary data related to this article:

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SOM1. The plan of the cairn and the artifacts from the ritual pit 1 at the Aigyrzhal-2 site, Kyrgyzstan.

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SOM 2A. The top section of the Aigyrzhal-2 stone cairn that was covering the pit 1.

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SOM 2B. The closer view of the in situ bones (horse vertebrate and ovicaprine tarsals) and wheeled pottery shard from the pit 1 of the Aigyrzhal-2 site.

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