



The Soundscapes of the Lower Chuya River Area, Russian Altai: Ethnographic Sources, Indigenous Ontologies and the Archaeoacoustics of Rock Art Sites

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Abstract

The acoustics of the Lower Chuya River area rock art landscape are analyzed through both the exploration of its acoustic properties and the ethnographic information gathered about the region. The results obtained in the acoustics tests undertaken in the area, in particular at the rock art sites of Kalbak-Tash I, Kalbak-Tash II, and Adyr-Kan, are examined. They indicate that the perceived loudness resulting from a natural amplification of sound (strength parameter) and music and speech clarity may have been some of the reasons behind the selection of these locations for rock art production. The ethnographic sources related to the Altai and other Siberian areas are then reviewed as a way of providing an ontological framework for the study of Altaian sonic concepts and behaviors in nature. As the sources indicate, at least for the historical period and presumably earlier, in the prehistoric period, all existing beings are entangled by sound, and they mimic each other in endless ways. We argue that these sites were selected in a non-linear relational ontological framework. It is suggested that the multidisciplinary perspective combining archaeology, physical acoustics, and ethnography has considerable potential for providing a new, richer understanding of rock art landscapes.

Keywords Archaeoacoustics · Altai · Siberia · Rock art · Ethnographic sources · Ontology

Introduction

In the last three decades, the shift in theoretical and methodological frameworks begun by post-processual archaeology which has led to growing interest in the fundamental role of the human sensory experience in the shaping of past cultures

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(*e.g.*, Classen *et al.*, 1994; Cummings, 2002; Tilley, 1994). In this context, archaeologists have been increasingly encouraged to delve into areas previously left largely¹ unexplored, such as ancient sound and music-making (Díaz-Andreu & Mattioli, 2019; Jiménez Pasalodos *et al.*, 2021; Morley, 2013). Attention began to be paid to the auditory dimension, and it is in this climate that the field of archaeoacoustics was born in the 2000s (Scarre & Lawson, 2006) with a focus on the formal and cultural study of soundscapes, music, and the acoustical characteristics of places inhabited or used by human beings in the past. Two major approaches have been followed for this. Researchers following the first began to investigate the acoustic characterization of archaeological sites, seeking links between particular elements in the archaeological record and acoustic properties, such as resonance, speech, and music clarity, or the presence of echoes (see for example Díaz-Andreu & García Benito, 2012; Díaz-Andreu *et al.* 2021b; Fazenda *et al.*, 2017; Mattioli *et al.*, 2017; Reznikoff, 2014; Reznikoff & Dauvois, 1988; Waller *et al.*, 1999). Also within this first perspective, other authors have investigated the psychoacoustic effects of these acoustic properties (Kolar, 2017; Pentcheva & Abel, 2017; Valenzuela *et al.*, 2020). A second major methodology used to study past acoustics, sound, and music is based on the study of oral and written sources in order to seek information regarding the possible epistemological and ontological frameworks in which these sonic behaviors took place (Alarcón-Jiménez *et al.*, 2021; Rusch, 2017; Waller, 2018).

There are still many regions with significant rock art traditions in which the archaeoacoustics have yet to be evaluated. Since 2018, members of the Artsoundscapes project (www.ub.edu/artscoundscapes) have been working with local archaeologists in new areas around the world with a view to evaluating the degree of connection between acoustics and the placement of rock art. The aim of the project is to assess whether acoustics was an element considered by past communities when choosing a place in which to paint or carve their visual representations, and to examine what this may reveal about ancient ontologies. Results so far have been published on the rock art of Baja California in Mexico (Díaz-Andreu *et al.* 2021a), the Yokuts area in California (Alarcón-Jiménez *et al.*, 2021), and Mediterranean Spain (Santos da Rosa *et al.*, 2021). We now provide the first account of the fieldwork undertaken in the Russian Altai region of southern Siberia in August 2019.

In this article, our aim is to analyze the acoustics of a rock art landscape; approaching it both from the exploration of its acoustic properties and through the ethnographic information, we were able to gather on the region. We focus on the Lower Chuya River area, where the Chuya watercourse flows into the larger Katun River. We first explain the results obtained in the acoustics tests undertaken in the area, in particular at the rock art sites of Kalbak-Tash I, Kalbak-Tash II, and Adyr-Kan. Secondly, we explore the ethnographic sources related to the Altai and other Siberian areas and suggest an ontological framework for the study of Altaian sonic concepts and behaviors in nature.

¹ For precedents and an earlier interest by musicologists see Jiménez Pasalodos *et al.*, (2021: 19–21).

The Rock Art of the Lower Chuya River Area

The Lower Chuya River area is in the Altai Mountains, a range in southern Siberia and Central Asia that stretches across four different countries, Russia, Kazakhstan, Mongolia, and China. There is a long tradition of rock art studies in Russian Altai. It was first investigated by explorers and artists such as N. Yadrintsev (1878–80) and D. Ivanovich Kuznetsov (1890–1979) (a disciple of G. Choros-Gurkin), followed by archaeologists such as A. Okladnikov, E. Okladnikova, V. Molodin, V. Kubarev, E. Matochkin, E. Jacobson, A. Martynov, E. Devlet, E. Miklashevich, and D. Cheremisin, to mention only the most active (see more in Devlet and Devlet 2011). The art is found mainly carved on the rock surfaces of mountains, boulders, stelae, and graves (on the latter also in the form of paintings, Kubarev 1988, 2009). It is surrounded by remarkable landscapes, characterized by valleys enclosed by imposing loess terraces and framed in the background by striking high mountains. An important factor for understanding the area is the Chuysky (Chuiskii) Tract, an ancient pathway (probably from the time of the Silk Road) that runs through the Altai Mountains from north to south. Today, it is a major highway of about a thousand kilometers that links the present-day city of Novosibirsk and the Mongolian border. The Chuysky Tract enters Russian Altai running parallel to the Katun River for a distance, before leaving it to pass through the Karakol Valley and joining it again before diverging from it for good at the confluence with the Chuya River. It is precisely at the latter point that the route makes an almost 90 degree turn towards the east, in the Lower Chuya River area. This is where the Artsoundscapes project studied three major rock art sites: Kalbak-Tash I, Kalbak-Tash II, and Adyr-Kan (Fig. 1).

The rock art of the Lower Chuya River area has been known for many years. Kalbak-Tash I was discovered by Kuznetsov and Gurkin in 1912 (Kubarev, 2011: 8), but we owe the documentation of the rock art of both Kalbak-Tash I and II mainly to rock art and Altai archaeology specialist Vladimir D. Kubarev (1946–2011). He began his investigation in the 1980s and finally published a major volume on Kalbak-Tash I in 1996, together with Altai art and prehistory specialist Esther Jacobson (Kubarev & Jacobson-Tepfer, 1996), with a later volume on his own (Kubarev, 2011). Kubarev published extensively on Altai prehistoric art, including a journal article about Kalbak-Tash II (Kubarev, 2007). The petroglyphs of Adyr-Kan, as well as the deer stone placed at the site, have been commented on somewhat sporadically (Okladnikov, 1961; Kubarev and Toshchakova, 1979; Kubarev 2003: Fig. 1; Kubarev et al. 2004).

The three sites have in common their location on the right bank of the Chuya river, next to the Chuysky Tract road, and the considerable number of petroglyphs carved in them, spread out on a variety of rock surfaces. Although future studies may refine the chronology, they reveal a wide period of activity, ranging from, probably, the Neolithic to the Turkic era and even later, with a major period of production from 3000 BCE to ca 500 CE. This means that the sites have been repeatedly visited by many generations since prehistory. Interestingly, the lack of patina on some motifs typologically dated to the earliest periods appears to indicate that some petroglyphs were either re-carved many years after they were

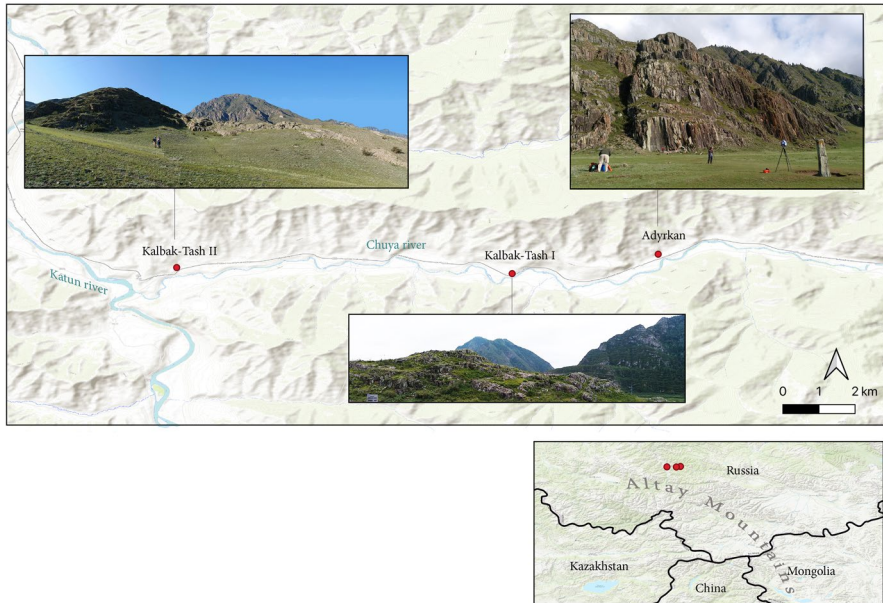


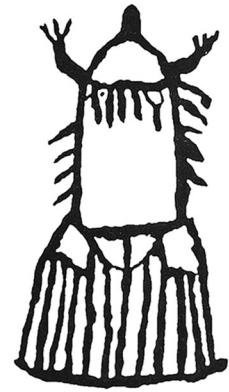
Fig. 1 Location map of the three sites with photos of the areas

first made or, as some authors claim, replicated. The latter alternative means that carvings were added to the panels emulating older styles, a process of replication that can also be seen in relation to places (making new motifs on old panels creating a palimpsest of images) and carving techniques (O’Sullivan, 2021).

Despite their commonalities, each of the three sites is different. Kalbak-Tash I, located on a relatively small ridge, has the largest number of motifs, some 3800 in an area of 500 m by 150–300 m. It has a number of unique, probably female, representations (Fig. 2, Fig. 8(a), mainly (B) area), most of them in horizontal panels, an uncommon feature in the context of Altaian rock art (Kubarev & Jacobson-Tepfer, 1996: I, IV). Also noteworthy is the fantastic beast, monster, or large predatory animal with its head facing downward, an open mouth exhibiting the tongue, and a long tail. It is carved on a slightly rounded vertical rock wall (Fig. 3a–c, Fig. 8(a, A)). On either side of the monster, there are small mushroom-hatted figures with spears. Above it, there are many other smaller carvings and below another group of mushroom-hatted figures in association with deer-like animals. As noted by Kubarev (2011: 43), the monster has parallels in the hybrid animalistic images related to the Bronze Age Okunevo culture in Khakassia (second half of the third millennium BCE–first half of the second millennium BCE). All around the site, there are also later carvings and engravings, even on horizontal surfaces, dated up to the old Turkic period (Miklashevich & Mukhareva, 2011: 233).

About 10 km to the west, at c. 1–1.5 km from the river junction, the site of Kalbak-Tash II is a rather large monument located on outcrops along the slope of a rocky ridge and also at the foot and on the slopes of a large mountain (Kubarev,

Fig. 2 Female motif. Photograph by Andrzej Rozwadowski. Drawing by Kubarev (2011: Fig. 48, 6)



2007: 282). At this site, the carved panels are found on rocks with flat, vertical surfaces that surround a kind of central area in an arrangement that very loosely resembles a theater. As at the first site, the rock art motifs also comprise zoomorphs, including elk, deer, horses, goats, predators, and other animal species from the Neolithic (?) to the Bronze Age period (Kubarev & Matochkin, 1992: Figs. 32, 34–36) (Fig. 4a, b). In a different style, from the Iron Age or Scythian era, there are large images of deer and wild boar (Kubarev, 2007: 284–286). There are also engravings from the Hun-Sarmatian Xiongnu and Turkic periods. In contrast to Kalbak-Tash I, there are no images of the period to which the women figures belong, as is also the case of Adyr-Kan, i.e., neither in Kalbak-Tash II nor in Adyr-Kan are there female representations.

The third rock art site at which Artsoundscapes project members worked in the Lower Chuya River area is Adyr-Kan. In addition to the carvings, it has some kurgans (tumuli) and also a deer stone or stela. The carvings are mainly at the intersection between the valley and the mountain, which here is oriented from east to west. Three major areas can be distinguished at the site. The most important is the middle area, where there are three panels with carvings dated to the late prehistoric and the protohistoric periods. The most profusely decorated is on a large vertical surface facing the deer stone (Figs. 5 and 6), whereas the other two are on either side of the beginning of a kind of corridor going up the mountain. The panel on the eastern side has many more motifs than the one on the western side. There are another two panels about a hundred meters to the east and west of the central panels. They have only a few motifs of goats that in both cases are looking towards the central panel (Fig. 7). In between the west and the central areas, there is, however, a later engraving, a fine Hun figure of a man with a crossbow.

The Lower Chuya River area is inserted into a wider region with abundant rock art. Comments about the acoustic of these places have almost been non-existent. However, there is an exception regarding Esther Jacobson and Vladimir Kubarev's

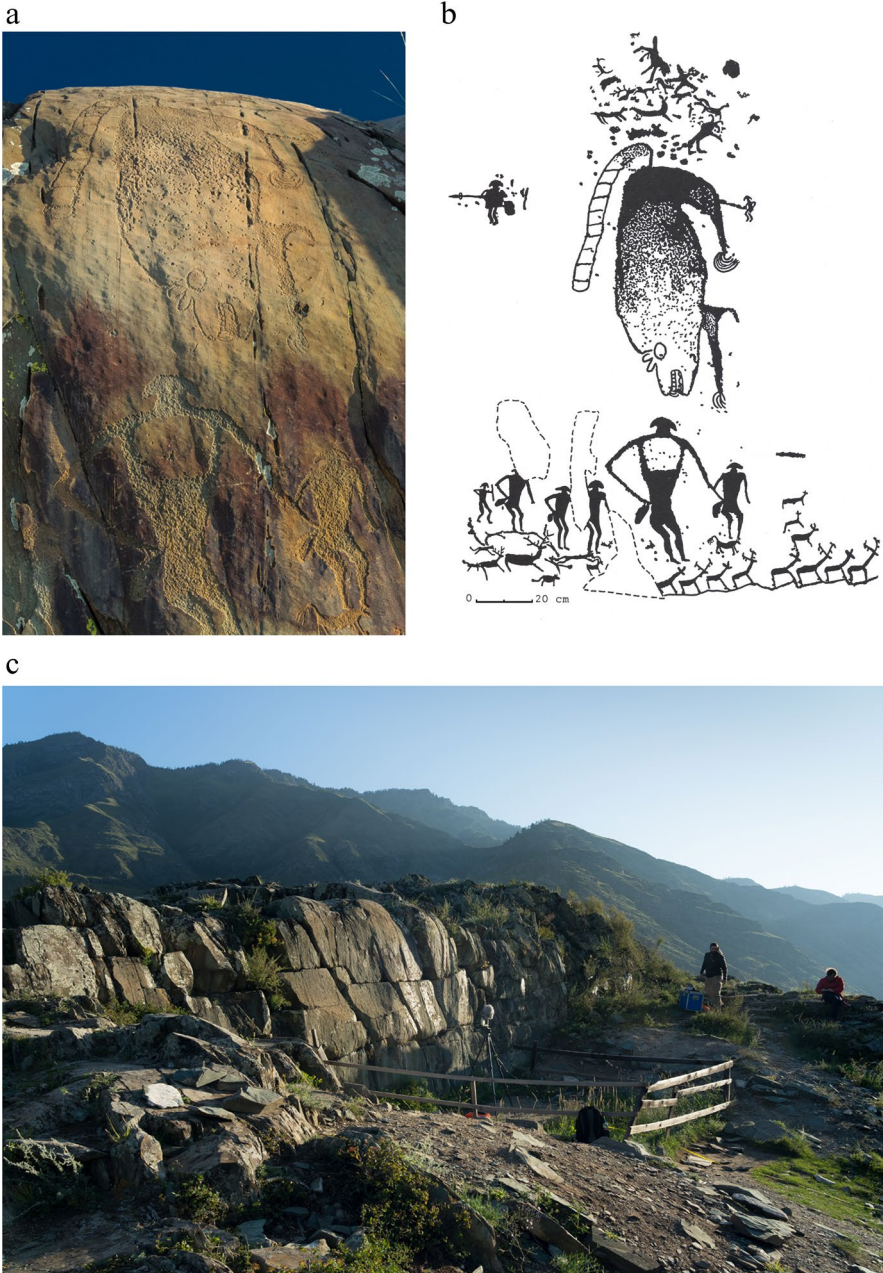


Fig. 3 a, b Kalbak-Tash I. Panel with a monster and mushroom-headed figures. Photograph by Andrzej Rozwadowski. Drawing by Kubarev (2002: Fig. 8). c Kalbak-Tash I. General view of the location with the panel with the monster and mushroom-headed figures

Fig. 4 Kalbak-Tash II. **a** View of the Chuya River Valley and Chuysky Tract, from the site. **b** Examples of petroglyphs associated with the Bronze Age. Photographs by A. Rozwadowski (see figure 8b, panel A).



Fig. 5 Performing acoustic tests at Adyr-Kan. Deer stone or stele in the foreground and main panel in the background. Photograph by Díaz-Andreu. 11 August 2019

Fig. 6 Adyr-Kan main panel.
Photograph by Díaz-Andreu



Fig. 7 **a** Adyr-Kan western area. Goat motifs looking towards the central panel. Prehistoric (scale added). **b** Adyr-Kan eastern area. Prehistoric Photographs by M. Díaz-Andreu

remarks about the acoustics of the rock art site of Turu-Alty (Jacobson & Kubarev, 1994, 21), 175 km to the east of our studied area. Turu-Alty is at the southern end of the Altai Republic in Kosh-Agach district, some 27 km from the Mongolian border, on the right bank of the Barburgazy River near its confluence with the Chuya River. These researchers divided the site into sections. In the bowl-shaped Sect. 9, they reported “the single most impressive concentration of ceremonial structures and petroglyphs.” These coincided with extraordinary acoustics, as sound was

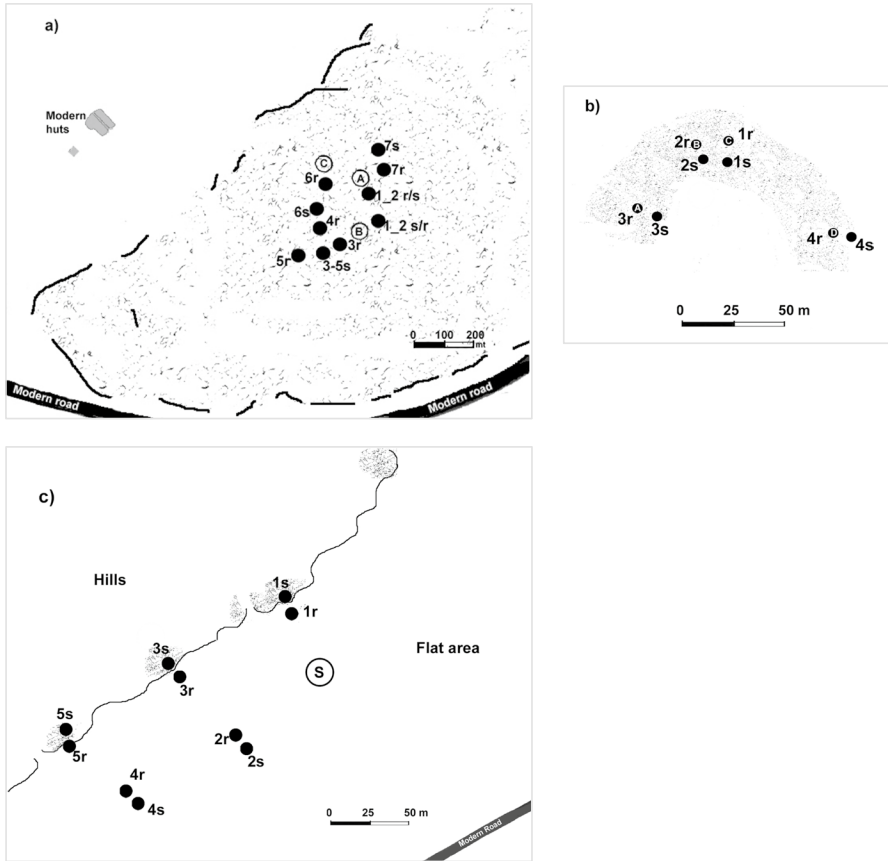


Fig. 8 Sketch maps of the three sites tested. Numbers refer to the test points; s: sound source; r: receiver. Scattered rock art panels are located in the shaded area. (a) Kalbak Tash I: (A) monster panel; panels (B) and (C), the closest panels, have a mixture of motifs of different periods, up to the Turkish period. The acoustic tests were performed in an area with high concentration of rock art motifs (b) Kalbak-Tash II: (A–C) panels with prehistoric carvings. (D) Historic carvings. (c) Adyr-Kan: all panels with prehistoric carvings except in test location 3

significantly amplified (Jacobson & Kubarev, 1994, 20–21). As they explained “a normal speaking voice at the top of the bowl could be clearly heard at the very bottom; the same clarity with respect to a normal speaking voice was true from one side of the bowl part of the amphitheater to the other” (Jacobson & Kubarev, 1994, 21). They proposed that “this particular characteristic of the bowl – or, as we will now call it, the amphitheater – helps, we believe, to explain the intense ritual use of this area over the millennia... Such natural ‘theaters’ could have been used for communal ceremonies involving the recitation of songs or epic narratives” (Jacobson & Kubarev, 1994, 21). The question to ask at this point is whether Turu-Alty is an exception in the area or there are other similar sites elsewhere and, in particular, in the Lower Chuya River area. The results of the acoustic tests undertaken in the latter will allow us to answer this question.

The Acoustic Characterization of the Rock Art Sites in the Lower Chuya River Area

The methods related to the acoustic characterization of rock art sites have been evolving over the last two decades. From intuitive approaches, the field has moved towards capturing impulse responses in controlled testing. Scholars have used a wide range of sound sources, including natural sounds (Goldhahn, 2002) and human-produced sounds, such as the human voice, clapping, and whistles (Díaz-Andreu & García Benito, 2012; Reznikoff, 2014). Also used are devices that produce a single loud percussion sound such as a starter revolver, a wooden percussion plate, a mouse trap, or a balloon (Mattioli *et al.*, 2017; Rainio *et al.*, 2014; Waller, 2002), as well as loudspeakers (Mattioli & Díaz-Andreu, 2017) and dodecahedron loudspeakers (Rainio *et al.*, 2018). Recording devices have also varied from simple tools, such as a chronometer and a sonometer (Goldhahn, 2002; Reznikoff, 2018), to a series of directional and omnidirectional microphones (Díaz-Andreu *et al.* 2021a; Fazenda *et al.*, 2017; Rainio *et al.*, 2014, 2018). Depending on the array of sound sources and recording devices, it has been possible to measure a selection of all the following parameters: resonance, sometimes in connection with particular pitches (Reznikoff, 1987), sound intensity (Goldhahn, 2002), reverberation (Díaz-Andreu & García Benito, 2012), echoes (Mattioli *et al.*, 2017; Rainio *et al.*, 2014; Reznikoff, 2002), and augmented audibility (Mattioli & Díaz-Andreu, 2017), as well as others such as speech transmission index (Fazenda *et al.*, 2017), music and speech clarity, apparent source width, and envelopment (Díaz-Andreu *et al.*, 2021a). Having had experience of several of these methods, methodology was considered a key aspect from the start of the Artsoundscapes project. This is especially due to the interdisciplinary nature of a project in which archaeologists work with acoustical engineers, ethnomusicologists, psychoacousticians, and neuroacousticians. In this framework, it was felt that there was a need for a new methodology to capture sound in a way that the two latter types of specialists—psychoacousticians and neuroacousticians—could use the results for their own experiments. In the case of our work in Siberia, such experiments will be the focus of a forthcoming article. In this article, our attention will be focused on the acoustic methodology followed in the Lower Chuya River area to characterize the acoustics and the discussion of the results, before moving on to how they should be interpreted in light of ethnographic sources on sound and music in the area.

Methodology

The methodology developed at the beginning of the Artsoundscapes project follows a path already trodden in previous work (for example, Mattioli & Díaz-Andreu, 2017; Mattioli *et al.*, 2017) with changes (see below), analyzing the acoustic properties of rock art landscapes through the on-site capture of impulse responses (IR) in the rock art landscapes under study. An impulse response is a signal containing all the information on how a site modifies a sound reproduced in a specific location and is perceived from a particular listener position. The methodology followed to gather the IR is an adaptation of the standardized methodology typically used

in performance spaces (ISO 3382–1, 2009), and the acoustical parameters used to evaluate the acoustic properties of the sites were also calculated according to the same standard.

For the fieldwork conducted in Siberia, new items of equipment were used. In order to trace the sound path between source and receiver, showing where each reflection occurs, a MIMO (Multiple Input, Multiple Output) loudspeaker array, a system first developed by Artsoundscapes senior staff member Angelo Farina (Farina & Chiesi, 2016), was used. We did so with a purposely built source system combined with a microphone array (Farina *et al.*, 2020). For the emission of the test signal (an exponential sine sweep), a customized dodecahedral speaker array together with a Zoom H2n recorder was employed (Fig. 5). The test signal was recorded at each receiver location using a 3rd-order Ambisonics Zylia microphone connected to a laptop. For the post-processing needed to convert the MIMO acoustical measurements to their corresponding IR, the Matlab programming software was used. The MIMO script² developed for the project included a command-line utility (AcouPar)³ for computing acoustical parameters according to ISO3382-1 (Farina *et al.*, 2020).

The acoustic measurements taken in the Lower Chuya River area included a significant number of acoustic tests.⁴ They were selected to cover the different source and receiver locations found to be relevant taking into account the morphology, the location, the type of rock carvings, and the functionality of the sites. Specifically, 5 tests in Adyr-Kan, 7 tests in Kalbak-Tash I, and 4 tests in Kalbak-Tash II were used in the acoustic analysis⁵ (Fig. 8). In all of them, the distance between the source and the receiver was about 10 m, with the exception of test 6 in Kalbak-Tash I, for which a source-receiver distance of 17 m was decided to cover a distance between two panels.

Results of the Acoustic Tests

The three parameters on which our discussion will be based on are sound strength (G), reverberation measure as reverberation time (T_{20mid}) and early decay time (EDT), and speech and music clarity, $C_{50mid} > 24$ dB and $C_{80mid} > 30$ db. As explained below, especially as regards reverberation and strength, not all of them gave good results, and in some cases the acoustics of the sites behaved in opposing ways. This, in itself, is an interesting result.

The first parameter that we analyzed was reverberation, which is the main descriptor of the way we experience the acoustic environment of a site (Beranek, 2004), at least by our Western standards today. Reverberation values will indicate

² The MIMO script by Angelo Farina is publicly available in the GitHub platform, https://github.com/xorgol/MIMO_Matlab

³ The Acoupar command line utility by Angelo Farina used for computing acoustical parameters according to ISO3382-1 is publicly available on his personal website, <http://www.angelofarina.it/Public/AcouPar/>. This code produces exactly the same results as the Aurora plugin named ISO3382 Acoustical Parameters, available on the same website <http://www.angelofarina.it/aurora/download/>

⁴ Each test refers to a particular pair of source and receiver locations.

⁵ In fact, those numbers correspond only to the valid test included in the analysis, although more tests were included in the initial survey but had to be rejected for technical reasons.

the appropriateness of a site for certain musical and ritual practices. The results at the three sites in the Lower Chuya River area, however, show low values for both reverberation time ($T_{20\text{mid}}$) and early decay time (EDT), which represent the actual reverberation time and the perceived reverberation respectively (Table 1). Furthermore, these parameters show a “linear” behavior in frequency, which suggests there are no special reverberation conditions in any frequency band that could be related to any particular practice or use of the space. These results were expected, as the three sites are located in what could be described as open-field conditions with a consequently low number of sound reflections. It is to be noted that a reverberation time under 15 ms, as seen in the Lower Chuya River area acoustic tests, favors speech transmission.

Secondly, the sound strength parameter (G) serves to objectively value the sound amplification that occurs naturally at a particular location. Our starting hypothesis was that there would be a positive relationship between a stronger perception of loudness and the selection of a place to be carved. Interestingly, the results are consistent to some extent with the hypothesis. As shown in Table 1, positive G_{mid} values of about 4 dB are found in some of the tests performed at Kalbak-Tash I and Kalbak-Tash II sites, indicating a natural amplification of sound in those places. The exception was Kalbak-Tash I tests 1 and 2, which were taken close to the rock art panel with the carving representing a beast or monster with

Table 1 Details of the acoustic tests performed in the Lower Chuya River area and the acoustic parameters’ results (mid values are frequency averaged at 500 and 1 k Hz frequency bands as defined in the ISO3382-1 (2009))

Test point	Rock art ¹	$T_{20\text{mid}}$ [s] ²	EDT _{mid} [s] ²	$C_{50\text{mid}}$ [dB]	$C_{80\text{mid}}$ [dB]	G_{mid} [dB] ²
Adyrkan test 1	●	0.06	0.02	34.0	37.1	4.4
Adyrkan test 2	○	0.07	0.02	–	–	0.2
Adyrkan test 3	○	0.15	0.03	24.9	31.5	0.1
Adyrkan test 4	○	0.05	0.02	–	–	–1.1
Adyrkan test 5	●	0.12	0.03	26.5	31.0	2.0
Kalbak-Tash I test 1	●	0.09	0.11	32.9	43.8	–0.7
Kalbak-Tash I test 2	●	0.09	0.07	34.0	42.7	–1.6
Kalbak-Tash I test 3	●	0.11	0.03	30.2	35.9	3.9
Kalbak-Tash I test 4	●	–	0.03	24.5	32.8	3.5
Kalbak-Tash I test 5	●	0.10	0.02	29.3	35.1	3.9
Kalbak-Tash I test 6 ³	●	0.06	0.06	28.2	35.0	2.0
Kalbak-Tash I test 7	○	0.10	0.02	34.5	44.4	4.0
Kalbak-Tash II test 1	●	0.09	0.05	28.9	34.7	5.2
Kalbak-Tash II test 2	●	0.09	0.04	27.8	33.5	3.8
Kalbak-Tash II test 3 ³	●	0.09	0.06	33.6	42.5	3.6
Kalbak-Tash II test 4	●	0.07	0.06	27.0	32.7	4.0

¹Black dots represent sites with rock art, and white dots represent spots without rock art in the immediate area

²The hyphen represents missing data due to technical reasons

³Source-receiver distance of 17 m, about 7 m further than the others

the head facing downward. These produced negative G_{mid} values, suggesting that no natural amplification of sound is experienced in that particular area. The results seem to indicate that in Kalbak-Tash I, the sound strength parameter does not appear to be always related to the selection of precise spots for decoration. In Adyr-Kan, a good result of the strength parameter is found precisely in the location of the rock art panel with more motifs (test 1), the main flat panel dated to the Bronze Age (Adyr-Kan Test 1) (Fig. 6, Fig. 8(c, 1 s)). Positive, but lower, values ($G_{\text{mid}}=2$ dB) were found close to the western panel, which also has a more motifs than its eastern counterpart. No natural amplification of sound was found in the rest of the tests performed at the site. In relation to the sites of Kalbak-Tash II and at Adyr-Kan, both containing spacious areas where large groups could have gathered, it should be noted that the perceived loudness is remarkable in the proximity of the petroglyph panels.

The absence of late reflections indicated above, which would have generated the reverberant field of the space, together with the early reflections probably emanating from the nearby hard rock surfaces, has a very positive effect in all three sites on speech and music clarity. This means that in all of them, sounds are perceived very clearly, when considering both music and spoken word as the stimulus. This is reflected in the extremely high values obtained for clarity parameters typically used for both parameters $C_{50\text{mid}} > 24$ dB and $C_{80\text{mid}} > 30$ dB in all tests (considering that recommended values in performance spaces are above 5 dB, including speech and a wide variety of music styles) (Harris, 1991). Although clarity parameter values are very high (above 15 dB) in all frequency bands, it is worth mentioning that the results show an average increment of approximately 8 and 10 dB for C_{50} and C_{80} in the 500 Hz, 1 kHz, and 2 kHz frequency bands, which is precisely the frequency range of the human voice with respect to the low frequency bands, and of about 4 dB for both parameters with respect to the high frequency bands.

The results of speech and music clarity, and especially those of sound strength, show that, even if the acoustics of the three rock art sites in the Lower Chuya area cannot be described as extraordinary as in Turu-Alty (Jacobson & Kubarev, 1994: 20–21), it is possible to find in all of the three sites high levels of speech and music clarity and in most tests a direct relationship between positive sound strength and the location of carvings. We would like to argue that more systematic acoustic testing of a good selection of rock art sites located in a larger territory may be needed in order to understand patterns in the similarities and differences that their acoustics may have. Differences may be related to the distinct functionalities of the sites (for discussions of this regarding other rock art areas around the world, see Lenssen-Erz, 2004; Martínez García, 1998). For instance, the importance of Kalbak-Tash I as a site of passage was probably the reason it was chosen for carving the rock surfaces. At the same time, its unique concentration of depictions of women assumed to be Neolithic and Chalcolithic may also indicate that this particular place had indeed a very specific use during those periods. Acoustics, therefore, was one of the aspects taken into account by rock art producers, but not the only one, and the other functions of the place may have also affected what acoustics were sought in particular locales.

Ethnographic Sources and the Archaeoacoustics of Altai Rock Art

As we saw in the previous section, the formal acoustical features of the three rock art sites in the Lower Chuya River area indicate that they are characterized by specific acoustical conditions, especially as regards sound strength and music and speech clarity. In this section, we explore whether one reason for the selection of places in which to place rock art may be the favorable acoustic conditions for the particular activities undertaken at those sites. We are referring to diverse types of gatherings in which rituals, sound-making, and storytelling may have taken place. In order to assess this possibility, we present a review of what ethnographic sources explain about the traditional and ritual practices conducted up to the present day, or until relatively recently, in this region. As we explain, these sources mention that sounds in the landscapes and music-making are inserted in a particular ontology in which human and non-human entities, such as spirit masters, animals, and natural features, relate sonically with each other.

The value of ethnography in rock art studies is widely acknowledged, although the way in which ethnographic data have been used has varied considerably throughout the history of rock art research. Ethnographic sources for the interpretation of the acoustics found at rock art sites have been assessed in North America (Arsenault & Zawadzka, 2014; Devereux, 2008; Díaz-Andreu *et al.*, 2021a; Liwosz, 2017; Loose, 2008; Rainbird, 2002; Waller & Arsenault, 2008; Zawadzka, 2011) and Europe (Äikäs, 2015; Lahelma, 2008) (see also a general overview in Díaz-Andreu *et al.* 2021b). In Asia, there are also several studies (or comments) related to the Indian subcontinent (Blinkhorn *et al.*, 2012; Boivin *et al.*, 2007; Chakraverty & Banerjee, 2015). Today, scholars commonly recognize the need for a critical analysis of the ethnographic sources and the careful consideration of the different epistemologies and ontologies involved (Brady *et al.*, 2017; Monney & Baracchini, 2019; Rogers, 2007; Sundstrom, 2012). Rock art scholarship has always been attentive to the wide range of conceptions of what constitutes the world (Whitley, 2021, 67–68). The ontological turn provides a further theoretical tool for understanding this. When studying the information gathered in ethnographical sources, an ontological perspective can help archaeologists overcome the traditional epistemological questions about how other cultures hear and interpret their sonic environment. They can then focus instead on what there is to hear and be heard, and how the different existing entities relate sonically with each other. Our aim in this section is to approach the acoustics of the Lower Chuya River area from an ontological perspective.

Altai Ethnographies

Ethnographic research has been conducted in the Altai and its neighboring regions since the late nineteenth century. Initially, much of the knowledge came from short trips undertaken by scholars (Lamazhaa, 2018, 2020: 203), but gradually this information was complemented by investigators who spent much more time living in the area. The first to do this was Vasily Vasilievich Radlov (Friedrich Wilhelm Radloff)

(1847–1918), a specialist in Turkic languages and a founder of turkology. He worked as a teacher in Barnaul (Altai) from 1866 to 1907 and focused his attention on southern Siberia, specifically the Minusinsk Basin of the Upper Yenisei River, to the northeast of the Altai area. In 1866, he published on the folk literature of the Turkic tribes of southern Siberia and the Dzungarian steppe (Radlov, 1866). The next major researcher, Grigori Potanin (1835–1920), was an explorer and natural historian who worked in many areas, including Mongolian Altai, about which he published his *Essays on Northwest Mongolia* (Potanin, 1883 (2005)). His extensive travels allowed him to establish ethnographic comparisons and identify tribal languages. In Mongolia, he distinguished between Mongolian, Turkic, and Chinese groups, each of them subdivided into many different tribes. He recorded that, despite the growing influence of Buddhism, shamanism was still practiced in the area (Lamazhaa, 2020, 203–204). His research partly overlapped in time with that of the missionary Vasily Verbitski (1827–1890), who worked in Russian Altai. His extensive body of research came out in more than a hundred publications on which many later researchers have based their studies. He wrote about the language, mythology, folk beliefs, and life of the Altai people and published a dictionary of the dialects of Altaic languages and tribal legends in the Altai mountains (Verbitsky, 1869, 1884, 1885, 1893). His work is still used today as a major source of information. This is partly because scholarship on ethnic religions and spirituality significantly decreased during the Soviet era. This type of research was considered part of the realm of the less important social superstructure and therefore not encouraged. Religion was seen as a method used by “low-culture” peoples to appease nature and its elements, as well as a way of manipulating and oppressing the masses (Lamazhaa, 2020: 204). Interest in these topics has only reemerged in the post-Soviet period, and many of the most important researchers will also be referred to in the following pages.

Returning to the last decades of the nineteenth century and the early twentieth century, it is essential to note an alternative source of information for us. As occurred in other parts of the world (Boas, 1888; Stumpf, 1886), novel research into local music was undertaken by a nascent science, musicology. In Altai, Russian ethnologist and musicologist Andrey Anokhin published his *Materials about Altaian Shamanism* in 1924. This, as well as many other later works published throughout the twentieth century (including Alekseev, 1984; Dyrenkova, 2012; Potapov, 1991), has shown that the Altaian culture shares many common features with other indigenous groups of southern Siberia that linguistically belong to Turkic-speaking peoples.

Our research for sources has not been limited to Altai. Because of the connections established by comparative ethnology between Altai and neighboring areas in southern Siberia and even beyond (Fig. 9), from the outset, we decided to widen our search for sources to a much larger area. In this article, we include information from the regions that incorporate part of the Altai Mountains in their territory, as well as others that border it, *i.e.*, Tuva, Khakassia, and the Kemerovo Oblast. Furthermore, based on linguistic and cultural affiliations, we also include accounts from the Turkic-speaking Sakha-Yakuts in the geographically distant Republic of Sakha. Evidence from other Siberian and especially Mongolian groups has also been collected in order to understand the spread of certain practices and ideas and provide more data, considering the scant interest shown by the sources in some of the subjects



Fig. 9 Map showing the areas covered by the sources with information discussed in this article

relevant to the research. For example, southern Siberia is home to Mongolian groups who share many common features with the Siberian Turkic populations, including ritual, mythological (Nekliudov, 1981), and musical practices, such as throat singing. Consequently, certain Mongolian and Buryat sources have also been consulted. Finally, considering the complex chronological and cultural contexts of Altai rock art (see Devlet & Devlet, 2005; Devlet & Seog-Ho, 2014; Jacobson-Tepfer, 2015, 2019; Rozwadowski, 2018) and the genetic relationship of other Siberian groups to the Bronze and Iron Age Altai inhabitants (Flegontov *et al.*, 2016), other Siberian groups will also be mentioned when relevant.

Music as a Sonic Pathway Between Humans and Spirits

The ethnographic sources consulted invariably reveal the importance of the landscape and its sacred places to local populations. These are usually inhabited by non-human entities called spirits or master spirits. Sacred places include large areas, such as a whole mountain, a mountain or a river passage, or different water masses. They may also consist of smaller locations like a cave, a rock, a crack in a rock, a tree, a spring, a well, and even a hole in the ground (Rozwadowski, 2017a: 68–81; 2017b, 2019; Tatar, 1996). Open fields may also possess special energy, and even archaeological sites are thought to be spirit dwellings. An example of the latter can be found in the Republic of Altai in the Karakol Valley (ca. 100 km from Kalbak-Tash I), where sacred places are common and include archaeological remains and petroglyphs (Dobson & Mamyev, 2010; Mamyev, 2014, 151). In Altai modern indigenous concepts, these sacred places are associated with special energies that formed the land over millennia (Mamyev, 2014). This can also be found in neighboring Mongolia (Humphrey, 1995; Pegg, 2006; Smyrski, 2018). Sacred places usually require rituals and offerings as a mark of respect for their spirit masters and to please them and ensure their protection (Anokhin, 1924; Petri, 1928; Potanin, 1883 (2005);

Znamenski, 2003, especially 191–192, 192–196, 211–220 with summaries of Petri, 1928; Potapov, 1934 and Potapov, 1991 respectively, Oelschlägel, 2016: 137–138; Smyrski, 2018).

Spirits Listen

Throughout Siberia, it is common for spirits to use specific locations from which to hear people, and they tend to prioritize musical sounds. For instance, for the Selkup of northwest Siberia,⁶ spirits listen to living people from the holes in the ground and rocks (Tátar, 1996, 269). Among the Nanai of southeastern Siberia, spirits only understand sung speech (Bulgakova, 1995, 135). In Altai, one of the most effective ways of pleasing the spirit master is by playing music and telling stories. In fact, among Tuvans, supernatural beings greatly enjoy this human art (Oelschlägel, 2016, 119). This sonic relationship between human and non-human beings is not merely important in terms of worshipping or pleasing the spirits, but also because it effectively influences people's well-being. As an example, Kenin Lopsan compiled a Tuvan story explaining that the people who lived along the Ene River were born with the gift of throat singing. The master-spirit of that place enjoyed listening to the throat singing and songs and fairy tales of the local people and, in return, turned frosty winters into warm summers (Kenin-Lopsan, 1997: 84). The connection between music and good hunting is also frequently noted in ethnographical sources. The ethnologist Évelyn Lot-Falck explains that a spirit master, attracted by music or storytelling, would indicate to the hunter how to be successful in the hunts on the following days. This practice was essential to the point that a professional musician or storyteller would go accompany the hunters to entertain the spirit masters of the place. His role was so critical that he would receive an equal share of the game. In Tuva, Oelschlägel recorded the testimony of a 44-year-old female, an anthropologist and folklorist from the Tuvan capital, Kyzyl, who confirmed that in the evenings Tuvan taiga hunters light a fire, boil tea, and always expect a talented storyteller to narrate a story or for someone to perform throat singing. Storytelling and singing are imperative as the taiga master, who is a young girl, enjoys this and, in return, ensures success in hunting (Oelschlägel, 2016, 120). The connection between hunting and music is also found among the Buryats, for whom singing and playing is also imperative in order to obtain the favor of the masters of the forest and, among the Yakuts, where hunters sing and make sacrifices in honor of Bai Baianai, the master spirit of the forest. The special relationship between hunting and music is also found among herders, who are among those who spend the most time in the landscape; they are often alone and perform throat singing to sooth the spirit masters and pacify their flocks (Behrs, 2014, 1).

In Altai, storytellers are known as *kaichi* and are considered to own *kai*. *Kai* is a special way of performing an *epos* (an epic poem), usually in the form of throat

⁶ They live in the following administrative districts: Tomsk Oblast, Krasnoyarsk Krai, Yamalo-Nenets Autonomous Okrug, and the Nenets Autonomous Okrug.

singing or khoomei. It is also believed to be the language of spirits, and the word *kai* is translated as “to float, to glide in the air, on the surface of water; to soar, to take off” (Sagalaev & Oktiab’rskaiia, 1990, 179), which illustrates the tangible conceptualization of these sonic threads. Singers, therefore, are particularly able to speak the language of spirits and are often mediators between the two realms. According to anthropologist Andrei M. Sagalev, singers were not only used as an effective means of ensuring successful hunts, but were sometimes invited into the home of a deceased person, as their singing helped the deceased soul to move on to another world. Sometimes they even stood in for shamans in this role, especially in winter, when shamans refused to perform their rituals, claiming that the upper sky of Ulgen freezes in winter, which makes their heavenly journeys impossible at that time of year (Sagalaev, 1992, 133).

Pleasing the spirits with talented music, however, may also be dangerous, as several folktales collected by Valentina Süzükei warn that a spirit may take a musician with them forever (in Van Deusen, 2004, 117–120). It is also dangerous to offend or disturb the spirits with certain sounds. Levin and Süzükei were warned by a local woman about disrupting a cave spirit with music (Levin & Süzükei, 2006, 32). In a personal communication, Dutch anthropologist Liesbet Nyssen (2019) also insisted on the idea among the Khakass people that it is important to maintain a respectful silence in sacred places, in order to not disturb spirit masters.⁷ This concept of spirit disturbance is also significant in terms of any other type of intervention in the landscape. According to Humphrey, in Mongolia, it is “wrong to move stones pointlessly from one place to another, or scuff the ground and make marks on it. Such marks must be wiped out with the foot before leaving a place. The circle left on the ground by a kettle should be erased” (Humphrey, 1995, 141). Thus, singing and sound-making is ritualized, as the intangible impact of sounds on non-human beings is as relevant as the effective alteration of the physicality of the sacred natural landscapes to which spirits are bound.

Spirits Sing

The previous accounts point to an ontological framework in which humans use music to relate to non-human entities. However, this sonic connection also works inversely. Oral traditions illustrate how the spirits are sometimes musicians themselves and

⁷ During our field research in Altai in the Lower Chuya River area, we talked to several local people who also confirmed the importance of not making noise in the close proximity of mountains, where spirits are believed to reside. Similarly among other Siberian peoples, it is important to respect silence prescriptions. In Selkup mythology, there are stories of the terrible consequences of disturbing the master spirits with sounds, and there are days when it is forbidden to dance and celebrate (Tuchkova *et al.*, 2009: 54, 104, 107, 123, 151, and 168). Among the Komi, it is forbidden to make noises near a particular rock resembling a human head; otherwise, a storm or snowstorm will occur (Konakov *et al.*, 2003, 216). The Khanty also had strict norms regarding compulsory silence in certain places (Kulemzin, 2003 (1976), 78). Among the Chukchee, loud noises are forbidden in the presence of bear or whale carcasses, and the noise of a rattle made by girls playing is said to cause thunder (Bogoras, 1907, 407 and 322).

their songs can occasionally be heard coming from caves and stones.⁸ One example of how an individual can learn music from a spirit, and the unusual events that may happen in this process, is recounted by ethnomusicologist Valentina Süzükei (2009). According to her, in Tuva, there is a tale about a man who sheltered from a thunderstorm in a cave. When he heard enchanting music coming from its depths, he followed the sound deep into the cave until he saw a light and a person singing and playing an instrument. After talking with this person and trying the instrument, the man left the cave only to learn, when he reached home, that many years had passed on Earth.⁹ The spirits who make music and alter the experience of time seem to appear in other myths. Another version (Levin & Süzükei, 2006, 31) describes how the *igil* (a two-stringed lute played with a bow) was introduced into Tuvan folklore. The story is about a shepherd who went into a “singing cave” and met a man who was throat-singing to the sound of a mysterious musical instrument, the *igil*.¹⁰ He begged the man to let him play it and immediately fell into a trance. When he came out of the cave, he found that a long time had passed. He then became an itinerant musician with his new instrument.

Anthropologist Andrei M. Sagalae (1992, 126–137) explains that having the gift of storytelling, which is performed through singing, is seen by Altaians as a process analogous to that of being a shaman. Storytellers receive it from the *kai-eezi*, i.e., the spirit ruling *kai*. In Altai, it is commonly believed that the storyteller receives their gift from the spirit of the mountain. The storyteller’s relationship with the *kai-eezi* is equivalent to that of the shaman with their tutelary spirit. In search of their gift, some storytellers used to go into seclusion inside a mountain, where they sought contact with the spirits (Sagalae, 1992, 130). According to some stories, a hunter enters the interior of the mountain, where a beautiful woman, enchanted by the shaman or shamaness, is waiting for him playing the *komys*. The idea of receiving the gift of music from mountain spirits is also well recognized among the Khakas (Burnakov, 2006, 35). The songs storytellers sing are thus the voices of the spirits, and the storyteller acts as an intermediary with the world of other-than-human beings.

Soundscapes and Musical Aesthetics

As we have seen, humans and spirits both have sonic agency and, in this framework, music enables the intricate interconnection between these two existing entities. Spirit songs and sounds inspire and gift musicians, who in return play to please the spirits, and these sonic pathways ensure the well-being of both humans and spirits.

⁸ An example of this can be found in Altai and surrounding areas in popular tales about *almyses* (singular *almys*). These are other-than-human beings who take on human form (usually of women to seduce hunters). They are believed to live in the interiors of mountains or in the lower world, and use rock openings (cracks, caves, etc.) to enter the world of humans (Doronin, 2016; Rozwadowski, 2021: 10–11). Anett Oelschlägel (2016: 90) informs us of the story of an *albys* (a Tyvan variant of *almys*) who lived in a specific rock from which its laughter, songs and cries could be heard in the outside world.

⁹ Another version of this story is given by Süzükei and Van Deusen (2004: 131–132).

¹⁰ There are other folktales that explain the creation of this and other instruments, such as the chatkhan or Tuvan box zither (see Van Deusen, K. (2004).

Nevertheless, these two entities, humans and spirits, are both ontologically dependent on other types of entities: the landscapes and their natural features. For instance, to its inhabitants, Altai appears as a huge living entity and is referred to as Khan-Altai, *i.e.*, “Great Altai/King Altai.” Khan-Altai is perceived as a living organism in which every mountain, river, lake, spring, tree, and plant is its living part. These features are therefore living entities that are inhabited by host spirits, as well as by animals and humans (Anokhin, 1924; Dyrenkova, 2012, 131–188; Halemba, 2003; Potanin, 1883 (2005), 123–130; Potapov, 1991; Sagalaev, 1992; Smyrski, 2018).

Features in the landscape are not only tangible and visible but also audible. The soundscapes of Altai mountains shape the musical aesthetics shared by both people and spirits because “nature is alive and nature sings” (Levin & Süzükei, 2006, 28). The sonic agency of nature is the origin of the most important musical style of the Altai area, *khoomei* or throat singing, the favorite style of both humans and spirits. Several stories about the origin of throat singing in South Siberia link humans and spirits to natural soundscapes. In Tuva, one account explains that it was an orphan boy at the foot of a cliff who, while trying to imitate the echo made by the air and the rocks, first produced a singing style that people called *khoomei* (Van Deusen, 2004, 112). Similar ideas about the natural origin of throat singing have also been collected in western Mongolia (Levin & Süzükei, 2006, 39–40; Pegg, 2001). Animals can also inspire humans with their songs. In Altai, Sagalaev (Sagalaev & Oktiab’rskaja, 1990, 127–129) mentions a legend of the Shor people of the Kemerovo Oblast in the northern part of Altai about bulls singing in the taiga, with songs that recalled their homeland. Once, a hunter who had heard this song while in the taiga began to sing it himself, and in this way, he became a *kaichi* storyteller. Consequently, the gift of singing or storytelling is not always dependent on a tutelary spirit but can also come from the living and agentive nature of Altai, Khan-Altai itself, or that of other living entities that conform to it, such as natural features and animals.

The musical inspiration in nature is not exclusively conceptual or representational but can be sonically mimetic. *Khoomei* is usually the chosen singing style in the landscape because master spirits are especially pleased by the songs that imitate the sounds of the place they inhabit. However, these songs are performed both for pleasure and as offerings to the spirits (Levin & Süzükei, 2006). The musical aesthetics privilege a complex timbre that evokes the dense layers of natural soundscapes. In order to please the spirits, the singer must then imitate the water streams, the wind on a mountain, the birds, the animals, etc. Moreover, humans and other natural entities sometimes relate directly through music-making. In Tuva, water streams and echoes perform together with humans, and they guide the performer on how to sing, making the resulting song pleasant for the spirit masters¹¹ (Levin & Süzükei, 2006). Another

¹¹ In Tuvan song lyrics, the singer sometimes even asks the rocks and mountains to provide their echoes, as compiled and translated into German by Erika Taube (2008, 104), probably for an aesthetic pursuit but also to make the spirits happy: “Gib dein Echo, roter Fels! / (Ihr) Mädchen, ältere Brüder, last (eure) Stimme hören! / Gib dein Echo, schroffer Fels / Einziger älterer bruder, lass deine Stimme hören” [Give me your echo, red stones / Oh, girls, my older brothers / Give me your echo, red stones / let me hear your voice, just you, my older brother, let me hear your voice].

account by Danish traveler and anthropologist Henning Haslund-Christensen (1896–1948) explains how in Mongolia singers may play with the echoes after testing the acoustics of the valley (Haslund-Christensen, 2000 (1935), 272), in a fashion similar to that described by Levin and Süzükei (2006). Natural entities' songs can not only interweave with those of humans but also reinforce them (Levin & Süzükei, 2006, 31). In Tuva, Levin and Süzükei attested that reverberation from caves and other naturally reverberant spaces (cliffs, valleys, mountains, etc.) are considered especially suitable to better reach the master spirits with their music (2006, 37).

Finally, not only spirits communicate with humans through sounds; other entities also have sonic agency that affects and interacts with humans. Examples of these can be found in Tuva: the singing caves that make sounds when the wind blows across their entrance (Levin & Süzükei, 2006, 31); the mountain that sings three hours before a storm arrives to give the people time to round up their animals (Kenin-Lopsan, 1997: 80; Levin & Süzükei, 2006, 39). Shamans are especially capable of understanding and interpreting these sounds. Other supernatural beings can also be heard in the landscape. For instance, Kenin Lopsan records a story about a particular cave where a dragon dwelt. When it sounded like a thunderstorm, it meant that the dragon was angry (Kenin Lopsan 1987: 83).

Contrary to the Western worldview, natural or supernatural sounds and human music are neither categorically separate nor static. The same sonic culture and practice are shared across the different entities. This conceptualization resounds with Viveiros de Castro's Amerindian multinaturalism (Viveiros de Castro, 1998). Furthermore, the different sonic manifestations are only discernible by their mutual relations. All existing living entities, non-human beings (natural or supernatural, tangible or intangible) and human beings, have sonic agency and, very often, interrelate with each other through the intangibility of sound and music. Much like the ontological dependence of humans and spirits on natural features and landscapes, natural soundscapes shape the musical aesthetics and behavior of humans and spirits. However, at the same time, natural entities can be affected and transformed by them. In this way, by making music, human and spiritual entities not only interact with each other, but also ensure their mutual well-being.

Conclusion

In this paper, we first presented the results of the acoustic characterization of three rock art sites of the Chuya River valley in the Lower Chuya River area, Kalbak-Tash I, Kalbak-Tash II, and Adyr-Kan. We concluded that the perceived loudness resulted from a natural amplification of sound (objectively quantified with the strength parameter *G*) and that music and speech clarity could have been one of the reasons that influenced the selection of rock art locations. These results coincide with Acoustics Section 9 of the Turu-Alty rock art site, 155 km to the east, up the Chuya River, especially in terms of sound strength (Jacobson & Kubarev 1994). We propose that these sites may have served as gathering spots where certain rituals and offerings involving sound, speech, or music-making may have taken place in different chronologies up to modern times.

In order to understand the ontology of the communities that used the sites, we compiled a selection of ethnographic sources that may illustrate some of these ritual and sonic practices. We also explained the significant cultural role of soundscapes and acoustic phenomena in historical times, both in South Siberia and in other related areas, and to what extent they may have shaped sonic and music culture. Furthermore, these sources also allowed us to situate the acoustical characteristics of rock art sites in a relational framework that does not constrain reality into a dualistic division between nature and culture, or between ecology and cosmology. As the sources indicate, at least in the historical period, and presumably earlier in the prehistoric period, all existing beings were entangled by sound, and they mimicked each other in endless ways. The sonic agency of natural entities shapes the music aesthetics of humans and spirits, not only conceptually but also audibly. At the same time, spirits' sonic agency often conforms to human musicking by gifting musicians with musical instruments or special talents. In turn, humans' sonic agency affects the behavior of spirits, which consequently may alter nature to the benefit or detriment of people. Sometimes, natural entities may even sonically imitate or help human sounds to better reach the spirit realm. In the Lower Chuya River area, the non-linear relational ontological awareness of the landscape and the acoustical properties contributed to a few sites being selected for the production of rock art. The sites were selected in an area already considered to be special by the local populations because of the confluence of two major rivers, the Chuya and the Katun. Acoustics and location may also be the reasons the site was repeatedly visited generation after generation, period after period, from the Neolithic to the Middle Ages and even later. The mythological stories that the carvings in the three tested sites most likely portrayed may have been understood for several generations. Yet, their meaning had long been lost and forgotten by the time the ethnologists arrived in Altai. It is highly possible that the stories represented in the carvings were the focus of at least part the storytelling and singing taking place at the sites.

The conjunction of the two main methodologies of acoustic research, the acoustic characterization of archaeological sites and the use of informed methods through ethnographic sources, have allowed a new, richer understanding of Lower Chuya River rock art. Furthermore, the results of this study highlight not only the influence of acoustics in the decision of prehistoric artists as to where to place their visual representations, but also call into question the validity of the exclusivist materialist paradigm that guides traditional archaeology. The contribution of sensory approaches in general, and archaeoacoustics in particular, is able to shed much light on angles so far unexplored in the study of the cultural practices and the symbolic behaviors developed by past communities.

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Data Availability The datasets generated by the survey research and analyzed during the current study are available in the University of Barcelona repository at <https://doi.org/10.34810/data151>.

Declarations

Competing Interests The authors declare no competing interests.

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