

**Archaeological trails and contemporary art  
Soundscapes for visually impaired visitors**

Antoniou, Angeliki; Love, J.S.; Lykourantzou, Ioanna; Gu, Heng; Stathi, Maria

**Publication date**

2024

**Document Version**

Final published version

**Published in**

Proceedings of the First International Workshop on Accessibility and Multimodal Interaction Design  
Approaches in Museums for People with Impairments

**Citation (APA)**

Antoniou, A., Love, J. S., Lykourantzou, I., Gu, H., & Stathi, M. (2024). Archaeological trails and contemporary art: Soundscapes for visually impaired visitors. In C. Fidas, S. Sylaiou, T. Kuflik, F. Liarokapis, P. Koutsabasis, M. Wallacw, D. Koukopoulos , A. Antoniou , K. Mania, & I. Lykourantzou (Eds.), *Proceedings of the First International Workshop on Accessibility and Multimodal Interaction Design Approaches in Museums for People with Impairments* (pp. 9-16). (CEUR Workshop Proceedings; Vol. 3622). CEUR-WS.

**Important note**

To cite this publication, please use the final published version (if applicable).  
Please check the document version above.

**Copyright**

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

**Takedown policy**

Please contact us and provide details if you believe this document breaches copyrights.  
We will remove access to the work immediately and investigate your claim.

# Archaeological trails and contemporary art: soundscapes for visually impaired visitors

Angeliki Antoniou<sup>1</sup>, Jeff Love<sup>2</sup>, Ioanna Lykourantzou<sup>3</sup>, Heng Gu<sup>2</sup>, and Maria Stathi<sup>4</sup>

<sup>1</sup> University of West Attica, Ag. Spyridonos 28, 12243 Aegaleo, Greece

<sup>2</sup> TU Delft, Postbus 5, 2600 AA Delft, The Netherlands

<sup>3</sup> Utrecht University, Heidelberglaan 8, 3584 CS Utrecht, The Netherlands

<sup>4</sup> Ephorate of Antiquities of East Attica, Mpoumpoulinas 20-22 str, 10682 Athens, Greece

## Abstract

The paper presents the initial stages of a project that wishes to create soundscapes for people with visual impairments at the archaeological site of Souriza-Agrileza (Greece). The students of a music school collaborated with the archaeologists from the local ephorate of antiquities in order to provide appropriate sound clips that would be incorporated in the site, thus “translating” what students see to sounds and music for visitors with disabilities. In addition, the paper includes a relevant literature review that guided the design of the project.

## Keywords

soundscapes, visually impaired, cultural landscapes, heritage sites


## 1. Introduction


In October 2022 the Ephorate of Antiquities of East Attica (<https://web.archive.org/web/20230616072022/https://www.efaanat.gr/>) opened a new archaeological trail to the public in Souriza-Agrileza Valley of Lavreotike. The southernmost region of Attica (Greece), the Lavreotike Peninsula, was a part of the ancient city-state of Athens. The Souriza-Agrileza valley is part of the larger Lavrion mining region. The remnants of old mining and metallurgical activities, including mine galleries and shafts, and ore washeries, are concentrated in the valley. The Lavrion mines were one of the most significant sources of income for the Athenians during the Classical era. The city-state of Athens was developed and became a powerful force as a result of the mines’ systematic exploitation. The Lavrion mines resumed production in the 19th and 20th centuries following the foundation of the modern Greek State. Along with shafts, the old galleries were renovated, or new ones opened. Infrastructure for the miners was also needed, including housing, transportation etc., thus Lavrion became a lively town. Today visitors to the Souriza-Agrileza valley can enjoy the archaeological trails inside the Lavrion nature reserve in full view of the Aegean Sea (Fig. 1) and along the path visit metallurgical workshops (Fig. 2), ore cleansing workshops and numerous traces of ancient mining activities, as well as remains of the mining activity of the last 200 years.


---

AMID 2023 - Workshop on Accessibility and Multimodal Interaction Design Approaches in Museums for People with Impairments, September 27, 2023, Athens, Greece

✉ [angelant@uniwa.gr](mailto:angelant@uniwa.gr) (A. Antoniou); [j.s.Love@tudelft.nl](mailto:j.s.Love@tudelft.nl) (J. Love); [i.lykourantzou@uu.nl](mailto:i.lykourantzou@uu.nl) (I. Lykourantzou); [H.Gu@tudelft.nl](mailto:H.Gu@tudelft.nl) (H. Gu); [mstathi@culture.gr](mailto:mstathi@culture.gr) (M. Stathi)

 0000-0002-3452-1168 (A. Antoniou); 000-0002-4243-4128 (I. Lykourantzou); 0000-0001-7679-698X (H. Gu)

 © 2023 Copyright for this paper by its authors.  
Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).

 CEUR Workshop Proceedings (CEUR-WS.org)



**Figure 1.** Part of the Souriza-Agrileza archaeological trail



**Figure 2.** Ore cleansing workshop in the Souriza- Agrileza valley

The Ephorate of Antiquities of East Attica has roped off and prepared clear paths that are safe to navigate through the forest and between ancient ruins and gallery openings that are often large holes in the ground. In addition, one specific trail is made for people with mobility issues and is wheelchair accessible. Along the trails, visitors can also find information posts and resting areas. In the wheelchair-accessible trail, the information posts include information in the Braille Tactile writing system for the visually impaired, and there is a model of the archaeological site for people to touch and understand the layout of the site and the landscape. Being sensitive to matters of accessibility, the Ephorate wishes to enhance the experience for visitors with disabilities and go well beyond the informative material already offered in braille for the visually impaired. Sonic enhancements represent one promising route for increasing accessibility at the park, and the present work focuses on the concept of cultural soundscapes in order to enrich the experience and provide further aesthetic input for all visitors of the Souriza-Agrileza valley.

## 2. Cultural Soundscapes

A soundscape is a term used to describe an audio environment that listeners perceive as being all around them in space. It is primarily a conceptual tool. Creators and curators of soundscapes focus on how sounds are heard and comprehended by a person or a group of people. With the unique and temporal characteristics of the sound, the idea offers a comprehensive method of understanding a location [1]. The concept was introduced in 1969 by composer R. Murray Schafer [2]. Although the concept first appeared in the 60s, it is the last fifteen years that it has attracted researchers' attention [3]. Technological developments in recent years allow for richer captures of sound environments which serve as new tools for anthropologists [4]. Soundscapes are not limited to sounds, but also include associated environmental, social and psychological elements. Some of the ways soundscapes affect the behavior and the emotions of people are demonstrated in a study by Davies et al. [5], where a focus groups methodology, which used soundwalks, showed that the two primary elements of a soundscape's emotional response appear to be tranquility and vibrancy. Soundscapes are also interesting for urban planners, since the levels of sounds affect the quality of city life and need to be managed [6].

Within the domain of archaeology, there are cultural heritage artifacts and spaces that can only be understood with sound, such as the prehistoric ringing stones in Sweden. In this case, sound is necessary for visitors to have a more complete and multisensory experience [7]. Similarly, ancient instruments can be understood better when we can hear the sounds they produce, and this is a part of the archaeology of sound [8]. Sounds connected to the past are not housed solely in objects; they may also be sounds connecting to ancient nature, different types of human activity, etc. Reconstructions of archaeological sites typically focus on visual cues and essentially ignore the sounds of the past. Still layers of sound are important to complement and enrich the

visual experience for all visitors. In a location similar to Souriza-Agrileza, the importance of understanding past landscapes, including sound, was recently recognised through a representation of daily life in a Viking Age town with sounds of ancient workshops and other activities befitting the time [8]. Historical soundscapes continue to become more sophisticated. Primeau and Witte [9] have explored how humans perceive their larger surroundings by using GIS technologies to model soundscapes. Alongside these kinds of efforts, research communities focused on how historical disciplines have been developing tools and methods to model sound perception, incorporate sounds in GIS technology, and create soundscapes of the past [10].

The way sound is used in archaeology has changed over time. Even the terminology used to describe sounds has changed. Today we discuss more in terms of the study of sound archaeology and soundscapes which emphasizes the necessity of considering an archaeological site's entire acoustic ecosystem [11]. The emerging field of archaeoacoustics represents the codification of knowledge regarding sound from the past [12]. Overlapping this is the study of physchoarchaeoacoustics, one branch of which explores how sound was used in certain landscapes, and why ancient societies gave special meaning to locations with particular acoustical qualities [12]. Other uses of sound in archaeology include investigating past forms of language and dialects that are long lost [13].

Sound is an integral part of intangible cultural heritage, and we continue developing our collective practices for how to preserve and present them to provide more complete representations of the past. The temporal quality of sounds makes them evanescent in nature. Our interpretations of past soundscapes and our attempts at recreating or reinterpreting them feed into a larger discourse of contemporary sonic culture. Some of these currently lie under threat, and there are calls for urgent action to preserve some modern cultural soundscapes to preserve cultural identity [14].

The importance of sounds in cultural heritage and the way they connect “place and space, mind and body, cultural context and emotion” ([15], p.4494) make soundscapes ideal tools for providing rich cultural experiences to the visually impaired and anyone else willing and able to engage with them. The Souriza-Agrileza trails are a fitting environment to experiment further with the forms and functions of soundscapes. In addition to possessing archaeological sites which lend themselves to recognizable sounds, the valley is a natural reserve area, and at least one study has also shown that satisfaction with soundscapes increases when they are experienced in green spaces [16]. Research and design of soundscapes in cultural heritage environments are still in their infancy [17], and the present work wishes to go a step further and study how cultural soundscapes work for visitors with disabilities.

### **3. Accessibility for the visually impaired in outdoor cultural heritage**

Museums and other heritage organizations now prioritize accessibility and approachability in their mandates to the public. Cultural heritage institutions constitute possible spaces for expression and social activism to facilitate what Pruulmann-Vengerfeldt and Runnel [18] call cultural citizenship. Accessibility for visually impaired visitors has been approached from several angles, and in recent years efforts have been focused on experimenting with assistive technologies which could be employed following the principles of Universal Design [19].

The ways in which people experience and understand history are complex, and one of the practices we attempt to encompass the full scope of ways we engage and learn about the past is through multisensorial interactions [20]. Joy and Sherry [21] point to experiences involving multiple senses as a blending of two or more inputs into an individual's imagination. These facilitate aesthetic experiences - among which we may include most if not all interactions with cultural heritage - about which a person can reason and express in their own terms. Multisensory exhibits now seem to be widely accepted as preferable for creating moments of meaningful contact between visitors and objects.

Multisensory interventions created outdoors, and in other locations beyond the relatively controlled spaces of museums, introduce challenges with which we are only beginning to grapple.

As far as we know, no systematic study is currently dedicated to multisensory experiences or accessibility in outdoor heritage. Some elements may be inferred from general studies on heritage landscapes, such as the work of Paul Meurs' [22], along with a relatively small number of experimental studies that include the meSch case study on the Sheffield General Cemetery [23] and the interactive prototypes placed within Bunratty Folk Park [24].

With the notable exception of narration and storytelling available through audio guides, studies of how to incorporate sound into visitor experience of natural & cultural heritage have been fairly limited.

Auditory Augmented Reality (AAR) is relatively less explored compared to Visual augmented reality (AR), but it has been shown to aid the visually impaired [25, 26], particularly in the application of navigation [27, 28, 29]. Visually impaired individuals tend to favor paths with more reference points, as well as fixed and temporary cues, to form a linked-nodes style cognitive mapping [30]. Participants visiting the Andy Warhol Museum with AAR valued having a personalized experience without relying on sighted peers or joining a specialized tour [31]. It is worth noting that blind visitors sometimes visit museums for social reasons, and accessibility technologies should not overshadow opportunities to connect with fellow visitors.

#### **4. The Lavrio case study**

At the Souriza-Agrileza trails, the information for the visually impaired is only present on a specific path and not the entire route that is available to the public. In addition, the information that is available in braille is the same as for people with normal vision, explaining the use of the mines in antiquity and in the 19th and 20th centuries. Information about the landscape other than in the model is not presented. Nevertheless, what makes the Souriza-Agrileza trail an unforgettable experience is the combination of the ruins of the ancient mines and workshops with the nature around them. Located up in the mountain with great sea views and under pine trees, the trails provide an experience that engages all the senses, from hearing the wind and the birds to smelling the pine trees and touching ancient stones on the way. The experience cannot be simply explained with words.

To provide rich cultural experiences for all visitors, the help of the teachers and students of the Experimental Music High School of Pallini was requested in March 2023. The students of the school are between 12 and 18 years of age and they are intensively taught music on a daily basis. Most of them play at least three instruments and work with all aspects of music. Students play classical, as well as traditional Greek music and they are free to experiment with all musical forms and create their own music. At the school there are different music groups that include teachers and students, which focus on different types of music. Two groups responded to our call. One group is called "Music Bridges" and it specializes in east Mediterranean traditional music and the other group is the group of the "School Radio" specializing in sound engineering and preparation of radio music programs. In total, 25 students and three teachers participated in the project. The students would create short music clips for all the information posts of the archaeological trails. By the end of the project, the students will produce 14 one-minute sound files, which will be added on the information posts as QR codes, and all visitors will be able to hear the sounds on their phones as they visit the site.

The two music groups visited the Souriza-Agrileza trails and had a two-hour guided tour by an archaeologist of the Ephorate of Antiquities of East Attica. Students could choose one information post each (they could also work in couples) and had to study the informative material, inspect the environment around it, take photos, record sounds, and write down their feelings and any free associations that might come to their mind. All these would function as inspiration elements for their music clips. In addition, the radio group recorded nature sounds from the locations and filmed different parts.

## 5. Designing Universally Accessible Outdoor Soundscapes

Adding music to the existing curated experiences at Lavrio marks an attempt to apply and realize the seven Universal Design principles as expressed by Story, Mueller and Mace [32] in outdoor heritage settings. These principles are: 1. equitable use, 2. flexibility in use, 3. simple and intuitive use, 4. perceptible information, 5. tolerance for error, 6. low physical effort, 7. size and space for approach and use. One further aspiration here is to be more aware of the need for aural diversity in cultural spaces (cf. [33]), though we recognize that more can be done here as well. We make no claim to have actualized a rich panoply of meaningful sonic interactions in our case study; still the study marks one additional step in the direction of universality of experience.

After a canvas of recent and ongoing systems at similar locations, we ultimately settled on music as a means to enrich and include visitors to the park. The Sheffield Cemetery and Bunratty Park examples mentioned previously both contain a sound component as part of their designs. One novel piece of the soundscape concept in Lavrio is using music as an abstract form of communication. We here posit that an additional channel of experience can be conveyed through the abstraction of musical metaphor. Music here functions in a way similar to Ting's [34] experimental interactions for ceramics. Separate from, and in addition to, visual cues such as labels and signs, music brings an audio element to the visitor experience. The choice of music over other - more conventional - sound options, such as tour narration or reconstructions of historical noises is motivated by a desire to use it as an emotional channel between the heritage site and the listener. One further addition on our part has been incorporating music inspired by the site itself rather than borrowed from elsewhere. The music was composed by local adolescents encountering the site for the first time, an experience we expect will resonate with most site visitors.

We hypothesize that the introduction of music alongside the visual and tactile landscape of Lavrio will make visits to the park more universally accessible, meaningful, and memorable to park visitors. The Lavrio music is intended to be maximally simple to use (principle 3) by placing no physical demand (principle 6) on visitors and only a temporary cognitive task of listening to a short (around one minute) piece of music at a time of their choosing. As the music is emotive and interpretive rather than didactic or pedagogical, there are no prescribed means for experiencing it and thus little space for erroneous usage (principle 5) outside of the failure of devices emitting the music - an issue for any digital technology. We leave aside the possibility of personal frustration in trying to suss out a non-existent, 'correct' interpretation of the music in a given space.

As the musical soundscape remains conceptual, there remains some ambiguity in its next phase of implementation. Ideally, the music will be channeled through any device chosen by the visitors such as their phone as well as a borrowable device from the site for those who would wish it. The aim here is to ensure that all visitors can play the music and listen to it where and when they please (principles 1 and 2). Some uncertainty also remains concerning the 'legibility' of the music (principle four) as well as situating it within the outdoor space (principle seven). Further iterations with the input of visitors are forthcoming.

## 6. Conclusions

Cultural heritage sites are complex spaces in which innovation can take place. Durable values, such as a need for authenticity and preservation of space or environment, can color how novelty appears in these spaces, but there remains a certain freedom in the exploration of digital augmentations. Soundscapes in outdoor heritage can bring an added level of richness in experience and increased accessibility for people who might prefer aural interactions. In the form presented here, the soundscapes should also have a low financial cost in terms of implementation and upkeep. The delegation of some creative control to students also serves to empower these adolescents, a demographic traditionally underrepresented in heritage experiences. Music they

create represents their own interpretation of the site and a contribution to the heritage which can be passed on to later visitors.

As with all experimental interventions, there is no certainty about how the addition of soundscapes to heritage sites affect visitor experiences in either the short term or the long term. Deployment of the test case in Lavrion is set for later in 2023, at which point they can be tested at full-scale in live settings. We fully anticipate that refinements or reworkings of the soundscape concept will take place in future, ideally in conjunction with visitors and other communities with a strong interest in audio experiences of the site. Deployments of this concept in similar locations using this setup or some variant would also be valuable in demonstrating what it brings to diverse settings.

## Acknowledgements

We are grateful to the Ephorate of Antiquities of East Attica for their collaboration and continuous assistance. We are also honored to collaborate with the Experimental Music High School of Pallini and the very talented students and teachers. In particular, we would like to thank the music group “Music Bridges” and their teachers Ms. Koutrouli and Mr. Kolovos, as well as the music group “School Radio” and their teacher Ms. Levanti. It is also important to note that all involved parties worked voluntarily.

This research has been co-financed by the European Regional Development Fund of the European Union and Greek national funds through the operational program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH–CREATE–INNOVATE (project code: T2EDK01392).

## References

- [1] K. Kato, Soundscape, cultural landscape and connectivity. *Sites: a journal of social anthropology and cultural studies*, 6(2) (2009), 80-91 .
- [2] M. Helmreich, Listening against Soundscapes. *Anthropology News* (2010), <https://www.amherst.edu/system/files/media/1114/Helmreich%252520%252520Listening%252520Against%252520Soundscapes.pdf>, last accessed 2023/07/08
- [3] J. Kang, From understanding to designing soundscapes. *Frontiers of Architecture and Civil Engineering in China* 4 (2010), 403-417.
- [4] D. W. Samuels, L. Meintjes, A. M. Ochoa, T. Porcello, Soundscapes: Toward a sounded anthropology. *Annual Review of Anthropology* 39 (2010), 329-345.
- [5] W. J. Davies, M. D. Adams, N. S. Bruce, R. Cain, A. Carlyle, P. Cusack,... J. Poxon, Perception of soundscapes: An interdisciplinary approach. *Applied acoustics* 74(2) (2013), 224-231.
- [6] M. Raimbault, D. Dubois, Urban soundscapes: Experiences and knowledge. *Cities* 22(5) (2005), 339-350.
- [7] M. Hultman, Soundscape archaeology: ringing stone research in Sweden. *Time and Mind* 7(1) (2014), 3-12.
- [8] J. Schofield, The archaeology of sound and music. *World archaeology* 46(3) (2014), 289-291.
- [9] K. E. Primeau, D. E. Witt, Soundscapes in the past: Investigating sound at the landscape level. *Journal of Archaeological Science: Reports* 19 (2018), 875-885.
- [10] D. Mlekuz, Listening to landscapes: modelling past soundscapes in GIS. *Internet Archaeology* 16 (2004), 1-2
- [11] R. Till, Sound archaeology: terminology, Palaeolithic cave art and the soundscape. *World archaeology* 46(3) (2014), 292-304.
- [12] Valenzuela, J., Díaz-Andreu, M., Escera, C.: Psychology meets archaeology: Psychoarchaeoacoustics for understanding ancient minds and their relationship to the sacred. *Frontiers in Psychology*, 11, 550794 (2020).

- [13] M. Noonan, An archaeology of soundscapes: The theatre of Noëlle Renaude. *Studies in Theatre & Performance* 30 (1) (2010), 115-125.
- [14] P. Yelmi, Protecting contemporary cultural soundscapes as intangible cultural heritage: sounds of Istanbul. *International Journal of Heritage Studies* 22(4) (2016), 302-311.
- [15] E. Pietroni, Mapping the Soundscape in Communicative Forms for Cultural Heritage: Between Realism and Symbolism. *Heritage* 4(4) (2021), 4495-4523.
- [16] Z. Chen, T. Y. Zhu, J. Liu, X. C. Hong, Before Becoming a World Heritage: Spatiotemporal Dynamics and Spatial Dependency of the Soundscapes in Kulangsu Scenic Area, China. *Forests* 13(9) (2022), 1526.
- [17] C. Bartalucci, S. Luzzi, The soundscape in cultural heritage, in: *IOP Conference Series: Materials Science and Engineering*, pp. 012050, Florence, 2020.
- [18] P. Pruulmann-Vengerfeldt, P. Runnel, The museum as an arena for cultural citizenship. *The Routledge handbook of museums, media and communication*, 11. Routledge, New York, 2018.
- [19] R. Vaz, D. Freitas, A. Coelho, Blind and visually impaired visitors' experiences in museums: increasing accessibility through assistive technologies. *The International Journal of the Inclusive Museum* 13(2) (2020), 57.
- [20] N. Levent, A. Pascual-Leone, *The multisensory museum: Cross-disciplinary perspectives on touch, sound, smell, memory, and space*. Rowman & Littlefield, Lanham, 2014.
- [21] A. Joy, J. F. Jr, Sherry Speaking of art as embodied imagination: A multisensory approach to understanding aesthetic experience. *Journal of consumer research* 30(2) (2003), 259-282.
- [22] P. Meurs, *Heritage-based Design*. BK Books, Delft, 2017.
- [23] G. Avram, L. Maye, Co-designing encounters with digital cultural heritage., in: *Proceedings of the 2016 ACM conference companion publication on designing interactive systems*, pp. 17-20. ACM, Brisbane, 2016.
- [24] L. Ciolfi, M. McLoughlin, Designing for meaningful visitor engagement at a living history museum, in: *Proceedings of the 7th nordic conference on human-computer interaction: Making sense through design*, pp. 69-78. ACM, Copenhagen, 2012.
- [25] S. Blessenohl, C. Morrison, A. Criminisi, J. Shotton, Improving indoor mobility of the visually impaired with depth-based spatial sound, in: *Proceedings of the IEEE International Conference on Computer Vision Workshops*, pp. 26-34. IEEE, 2015.
- [26] F. Ribeiro, D. Florencio, P. A. Chou, Z. Zhang, Auditory augmented reality: Object sonification for the visually impaired, in: *14th international workshop on multimedia signal processing (MMSP)*, pp. 319-324. IEEE, Banff, 2012.
- [27] R. Albrecht, R. Väänänen, T. Lokki, Guided by Music: Pedestrian and Cyclist Navigation with Route and Beacon Guidance. *Personal and Ubiquitous Computing* 20(1) (2016), 121-145.
- [28] F. Heller, J. Schöning, Navigatone: Seamlessly embedding navigation cues in mobile music listening, in: *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, pp. 1-7. ACM, Montreal, 2018.
- [29] S. Russell, G. Dublon, J. A. Paradiso, Hearthere: Networked sensory prosthetics through auditory augmented reality, in: *Proceedings of the 7th Augmented Human International Conference*, pp. 1-8. ACM, Geneva, 2016.
- [30] W. Ugulino, H. Fuks, Landmark identification with wearables for supporting spatial awareness by blind persons, in: *Proceedings of the 2015 ACM international joint conference on pervasive and ubiquitous computing*, pp. 63-74. ACM, Osaka, 2015.
- [31] J. Yang, G. Sörös, Audio-augmented museum experiences using wearable visual-inertial odometry, in: *Proceedings of the 18th International Conference on Mobile and Ubiquitous Multimedia*, pp. 1-6. ACM, Pisa, 2019.
- [32] M. F. Story, J. L. Mueller, R. L. Mace, *The universal design file: Designing for people of all ages and abilities*, 1998, URL: <https://eric.ed.gov/?id=ed460554>, last accesses 2023/07/08.
- [33] W. Renel, Sonic accessibility: Increasing social equity through the inclusive design of sound in museums and heritage sites. *Curator: The Museum Journal* 62(3) (2019), 377-402.
- [34] W. Y. V. Ting, *Dancing Pot and Pregnant Jar?: On ceramics, metaphors and creative labels*, in: *Museum Materialities*, pp. 189-203. Routledge, London, 2013.