Tarim Basin

Filippo Testa

Ai Weiwei – Study of Perspective, Xinjiang, China, 1995

Intro

The Tarim Basin lies in Xinjiang, the westernmost region of China. Bordering 8 countries and over twice the size of France it is both the gateway and buffer zone to Central Asia, geographically defined by the enveloping Tian Shan mountains and the desert heart of the Taklamakan. The "strategic invisibility" of desert spaces accommodate the pursuit of activities out of public view and beyond the realm of judicial and civic oversight [1]. Between these zones lie the oasis towns and cities which constituted the ancient Silk Road and today hosts as a major route in President Xi Jinping's Belt Road Initiative, the economic and infrastructure project strengthening trade between Asia, Africa and Europe. It is a landscape rich in resources, and for that, it is also one of exploitation and contention between newly settled Han Chinese from the Nèi dì (central china) and the indigenous, of which the majority are Uyghurs. From 2009 to 2014, Xinjiang was marked by a period of violence as ethnic tensions reached knifepoint resulting in a severe government clampdown on the Uyghurs in a bid to stamp out religious extremification and terrorism. In a location where social stability is imperative for maintaining a foothold of such a strategic border condition and maintained access to key resources, indeed, these actions can be nationally justified. However, from a global standpoint, their methods resemble cultural genocide.

[1] https://www.e-flux.com/architecture/new-silk-roads/313103/invisible-desert/

Table of Contents

Collective Mapping

Borders & Territory of the Tarim Basin

Filippo Testa

On Borders & Territories

Deseert not deserted

Kashgar city is located in Xinjiang, the largest Chinese province located in the northwest corner of China. The Taklamakan desert is the largest desert in China and also resides in Xinjiang as a dividing geographic feature of the Tarim Basin and a component of the ancient Silk Road and contemporary Belt Road.

The oases cities of Xinjiang are geographically dispersed along the border of the desert and ecologically fragile, which makes them difficult to understand as a united whole. However, we've found that Xinjiang acts as a buffer between China and Central Asia with the Tarim Basin as a microcosm, an autonomous region with distinct geographic character and independence that links the Belt Road to China and Central Asia as a corridor.

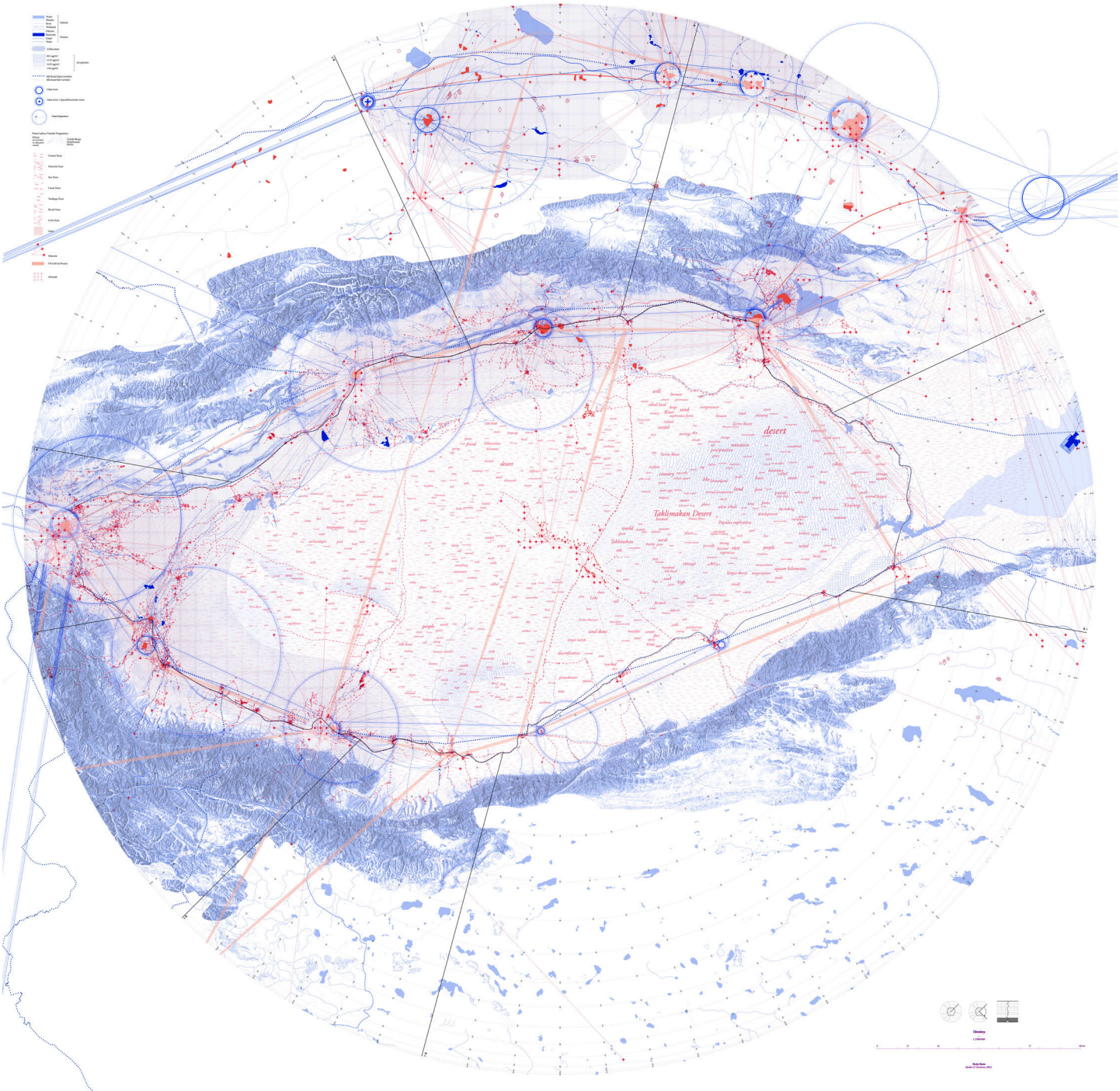
Kashgar city is only a small part of a greater system of exploitation being applied to the whole territory of Xinjiang, where Xinjiang is being treated as a tabula rasa within which to inject extra statecraft. We thus decided to expand the extents of our research to better understand the larger system.

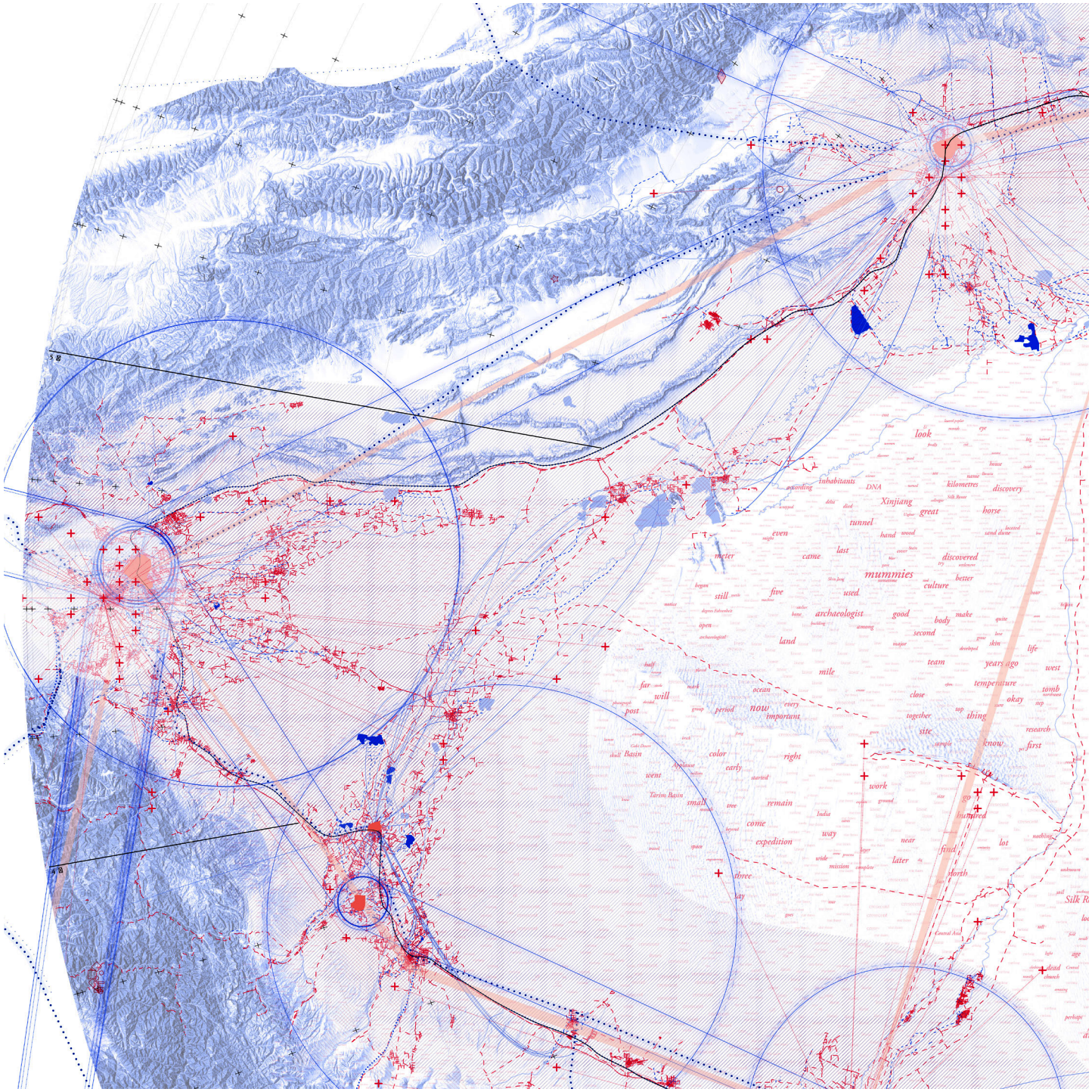
At first glance, the Tarim Basin appears to be an empty void. So, we approached the research obliquely by taking a larger sweep of the area and slowly build upon the findings. We found that while the desert appears to be barren, it is not. It's filled with activity, discourse, history, exploitation, and manipulation.
The narrative of Xinjiang as barren and deserted is maintained by an active obfuscation of the reality. This obfuscation allows the development/exploitation of the region to continue unhindered by external affairs or judgment. It became evident that the majority of available hard data spoke to everything outside of the desert, while everything inside was being found through more forensic means and abstraction, such as discourse analysis and comparison of satellite imagery.

The divide between inside/outside desert thus became a thematic reinforcement of the Tarim Basin as a territory being the mysterious void, while everything on the perimeter following the Silk Road being a opaquer construction – the Tarim Basin as a border and infrastructure for the Belt Road.

The layering of blue and red elements on the first map act as a filter for the two themes of borders & territories that allow us to both isolate phenomenon/patterns and see how they overlap.

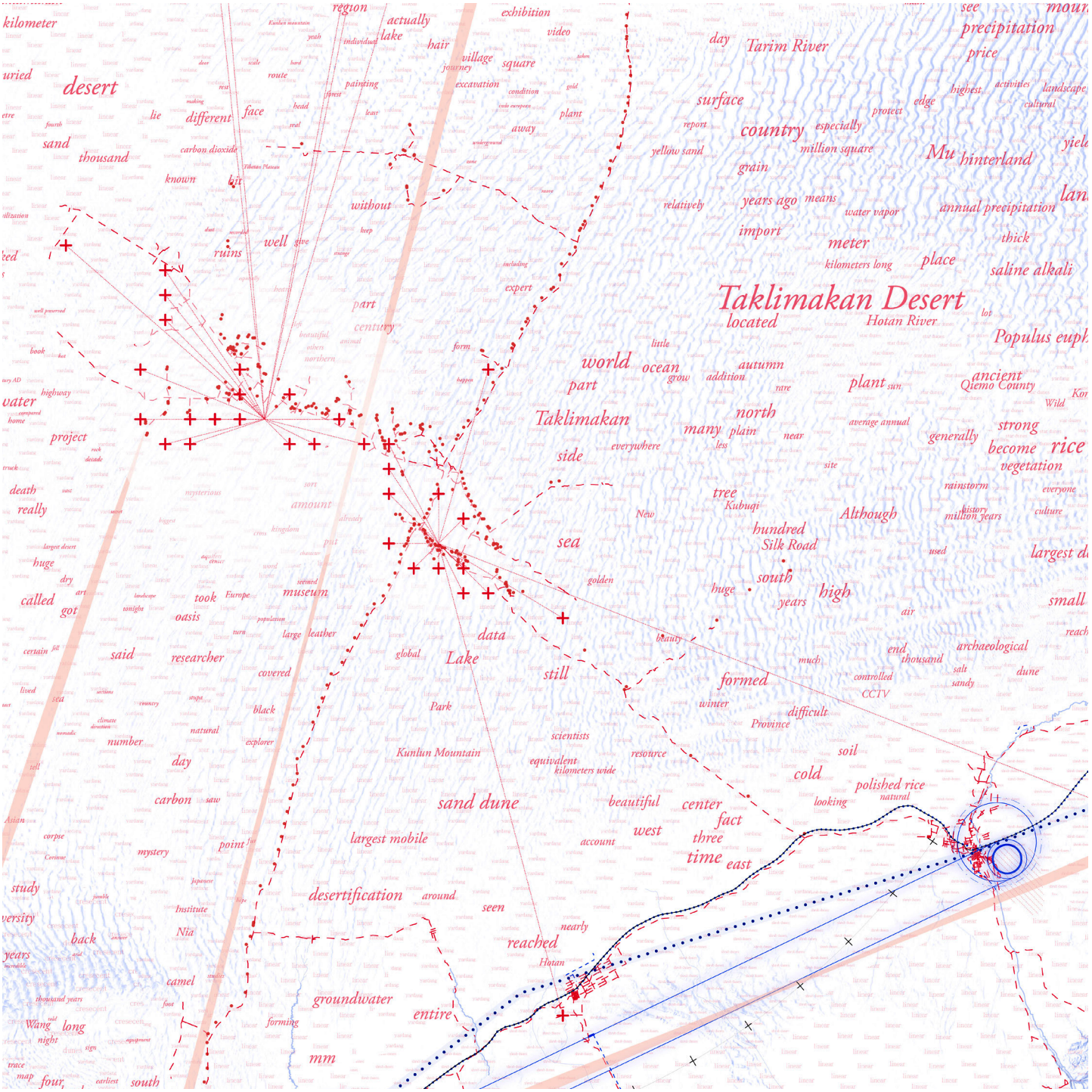
In the overlaps, we uncovered interdependent systems of exploitation that connect the Belt Road with: water systems, minerals and geology, de-extremification of the Uighur people, energy generation, and nuclear testing sites. Yet we quickly found a limit in the expression of these systems and thus attempted to reorganize the data in a further abstraction, to uncover thematic elements in the different zones of the basin. We also used this moment as an opportunity to branch out into our individual topics of research.


desert
Taklimakan Desert
desert



String of Pearls

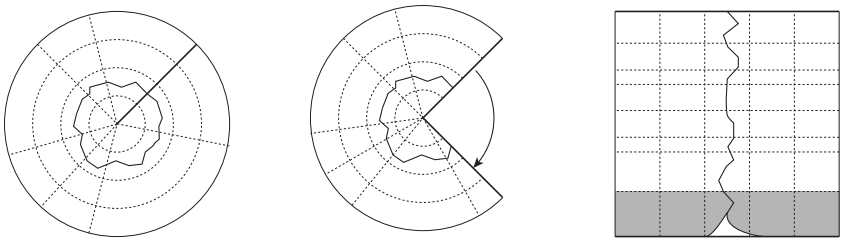
The oasis towns which lie on the perifery of the Tarim Basin function as a machine for the BRI project, a gateaway for central Asia and ultimately Europe.



Desert not Deserted

The Tarim Desert is a contradiction. Whilst appearing deserted, it is not. Applying a filter, we can discern clues, infrastructure, anomalies and different levels of land exploitation.

Along the Silk Road



How to read the map | As you drive along the road which defines the boundary of the Tarim Basin, to your right you will notice the endless expanse of the Taklamakan desert with all its oddities and activities. The left of your view becomes an index of exploitation which circumvents the desert heart.

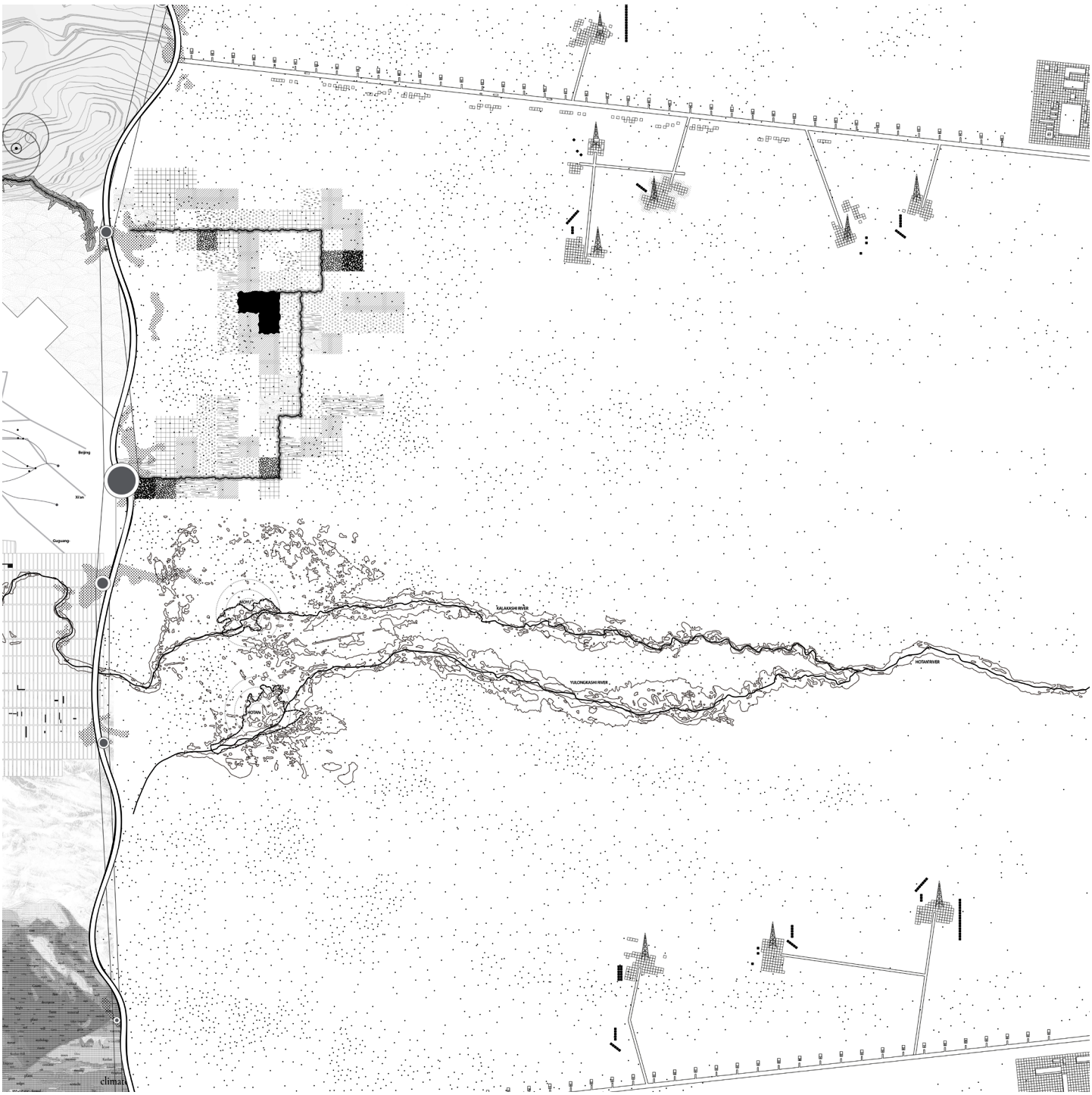
Slice 1, Lop Nur
Slice 2, Kunlun Mountains and the Tibetan Plateau
Slice 3, Aksai Chin
Slice 4, Hotan

Slice 5, Kashgar
Slice 6, Tarim River
Slice 7, Tian Shan Mountain Mining
Slice 8, Nuclear Test Sites


Tibetan Plateau
region
steppe
Qilian Mountain
Mountain
Plateau
climate
north
Platçau

Outside the desert

Each slice is an index of the area circumventing the Tarim Basin from the view of the road which delineates the inside from the outside. We divided the area into 8 sections which we saw defined by a certain manner of exploitation in the forms of mineral, oil, people etc.



Inside the desert

Within the desert, the slices cannot be so easily defined. As stated in the introduction deserts are useful at concealing activity, but this index serves to show there is still indeed human activity.

Individual research - Filippo Testa

Today's show, live from Xinjiang: "Death of a Territory"

Death of a Territory.

Absolute de-territorialization of the Tarim Basin

When we think about Rome, whether that being the imperial Rome, the fascist Rome, or the current Rome, we still identify it as the same place, somehow: a place that has kept its 'sense' throughout history, no matter the events that have caused it to change. A place has an identity, a 'sense of place' that pervades through changes. Can the same be said for the territory? If the identity of a territory is determined by its character (landscape), its meaning (culture) and the memory (people) of it, can it eventually cease to 'make sense'? This essay aims at defining the criteria creating the sense of place of a territory, and, by taking a journey through the modern history of one of China's most controversial province, Xinjiang, with a specific focus to the area defined by the endorheic basin of Tarim, to identify the processes that cause an absolute de-territorialization (borrowing the Deleuzian term), that lead a territory to a loss of sense, an unprecedented 'death' of a territory.

> "The integrity of a place suffers when what we learn by ear gets disconnected from what we perceive with the eye – still more when what we imagine seems irrelevant. The imagination makes sense. It is, moreover, an organ of perception – like our eyes, ears, and legs. We get to know a place when we participate in the local imagination. The whole synthesis of located experience – including what we imagine as well as the sights, stories, feelings, and concepts – gives us the sense of a place."[1]

Eugene Victor Walter, in his work Placeways: A Theory of the Human Environment argues over the experience and meaning of a place: he affirms that every single place does, clearly, not remain the same throughout history, but, despite the changes, some places continue to 'make sense' by maintaining their integrity, maintaining that geographical and architectural 'sense of place'. The integrity of a place is not merely connected to what the eye perceives, but it goes deeper than that, it has to do with a multitude of senses and experiences, as well as imagination. We identify places by the feelings or the atmosphere, more than solely by the geographical and architectural discourse. Something which is ephemeral, an almost intangible identity. When we think about Rome, whether that being the imperial Rome, the fascist Rome, or the current Rome, we still identify it as the same place, somehow: a place that has kept its 'sense' throughout history, no matter the events that have caused it to change.[2]

Thereupon, the author describes the constant changes as a loop, where the outcome, somehow, still holds the same 'feeling'. Especially in the case of urban environments, which tend to grow bigger or smaller, renewed or left into decay, declined and recovered, changing their appearance into a more pleasant one or not, based on ones' senses. Jane Jacobs well described this process as the 'death and life' of the cities[3], to which Walter added that the 'civic identity', the 'sense of the place', stays the same throughout the process.[4]

From Walter's 'places' to Jacobs' 'cities', this essay would like to shift the attention to a rather larger scale, where more relations are at stake and where the changes within a neighborhood become rather irrelevant to the discussion of integrity and sense: the notion of the territory. When identifying a territory, the focus shifts to the overall agendas and tendencies, rather than the singularities, and on the multitudes of places where the discussion becomes more intricate and less simplistic in its content.

How is the integrity of a territory defined then? What constitutes such? But most importantly, if Jacobs described the life and death of the cities as a loop of decline and rebirth, what happens once it becomes territorially a closed process, leading to an unprecedented loss of integrity? To simply put it: how can a territory cease to 'make sense'? Let us take this evaluation one step at a time by firstly denoting what concretely defines the integrity of a territory, to then understand which kind of changes these specific characteristics should face for it to, quoting Jacobs, 'die'.

Namely, Walter identifies three main aspects which, each alone, can determine the meaning of a place: what is perceived by the eye, what is learned by ears, and what sits in the realm of imagination.

Firstly: the eye. The initial perception is defined by what we see, by the physical matters that are giving the primary identity of a territory: its features, the landscape with its characteristics and properties, as well as the human interventions, infrastructures and architecture, literally giving shape to a territory. Nonetheless, this relies mostly upon the realm of nature: a territory can be such even without the touch of human beings. Shortly: the character of the landscape.

On the contrary, the second criterion is tightly connected to the human intellect and its influence: what is learned by ears. From the sound of a place, which characterizes different areas (i.e. a metropolis vs a rainforest), to the oral traditions passed between generations, shaping the perception of a territory. This way of discerning the identity is more abstract if compared to the mere physical properties, it has to deal with words, descriptions and possibly culture. The stories behind a territory are completely relying upon its inhabitants, and therefore their heritage, their past (history), filled with folktales, myths and truths, which all participate in creating the 'feeling' of a place, helping in identifying it even without seeing it. The meaning of a territory, which is embodied by the culture.

From the eye to the mouth and lastly the ears: this creates a cycle which informs the last principle: the imagination. The imagination that can only live in the mind of the people who inhabit the territory, and who at the same time shape their perception of it. The perception from which folktales, heritage and culture were born. The people are essential for this imaginative territory that can only survive in the mind, the people are feeding the memory of a place which is constituted of remembrances from the first two aspects. The memory of a territory, fed by its people.

So many are the aspects constituting the 'sense' of a territory, a

[1] Walter, E. (1988). Placeways: A Theory of the Human Environment (Illustrated ed.). University of North Carolina Press.
[2] Ibid.
[3] Jacobs, J. (1992). The Death and Life of Great American Cities (Reissue ed.). Vintage.
[4] Walter, E. (1988). Placeways: A Theory of the Human Environment (Illustrated ed.). University of North Carolina Press.

complex multitude of layers of understanding of it, which makes its 'death' hard to imagine. In this sense, the concept of de-territorialization comes useful in defining the crisis of the territory that we are trying to delineate. This process was introduced initially by Gilles Deleuze and Félix Guattari in A Thousand Plateaus (1980), but it is also often associated with Paul Virilio's Speed and Politics (1986). The concept, on one hand, derives from an understanding, by the French duo, of the territory as an element in a state of constant change, referring back to the 'rhizomatic structure' (another system introduced in the aforementioned book by Deleuze and Guattari): the 'movements of de-territorialization' are followed and connected to the 'processes of re-territorialization'[5], existing simultaneously. In what is known as 'relative de-territorialization'[6] , the first notion identifies a displacement, a discontinuity or dissonance, leading to a temporary dismantle of a territory, while the complimentary, re-territorialization, instead assembles and shuffles the pieces, leading back to a territory.
On the other hand, the two authors also identify the 'absolute de-territorialization'[7], marked by the impossibility of being territorialized again, where the notion of territory gets suspended, almost irrelevant and intangible. This condition leads Deleuze to the conclusion of the 'plane of immanence'[8], a state of rejection of the idea that life (creation) is opposed to death (non-creation).

For a territory to cease to 'make sense', the system involved shouldn't be the one of the feedback loop but rather an end-to-end process. Assuming this logic this essay borrows and focuses exclusively on the concept of de-territorialization applied to a territory at its absolute form. But, to be more specific on the subject, and avoiding the vagueness that surrounds Deleuze's theory, the exemplification of the concept is carried out through the analysis and application of it over the recent history of the Tarim Basin, an endorheic region of Chinese's north-western province of Xinjiang.

From a transitional region of strategic importance, both economically and geopolitically within the ancient Silk Roads, the whole region of the Tarim Basin has been undergoing a process of de-territorialization, or if one wants, de-naturalization of its territory, from every point of view. If the previous definitions of 'sense of territory' were tripartite into character, meaning and memory, it is now essential to highlight the strong link that those have to the more tangible elements which are constituting the territory (i.e. the landscape, the culture and the people) to discern the destruction leading to an unprecedented 'death' that a territory can suffer. Rich in recourses, the integrity of the region has been deeply destabilized from its core as demand grew exponentially over the past 50 years. This is key to the unravelling of the causes that have led to a territorial decline, which happened through the acute exploitation of land, culture and people (that we can still witness right now) in the region.
With the advent of modernity, the increasingly high demand for resources has caused an economic superpower like China to thoroughly inspect the country in search of them, finding in Xinjiang a territory rich in oil, gases and minerals, besides its being the biggest water reservoir of the whole country, holding an outstanding investment potential. Following the Great Leap West of the 1960s (mass migration of Han Chinese communities to Xinjiang, in an effort to abate ethnic tension by the increasing economic importance of the region), the Tarim Basin has witnessed an extensive act of exploitation of its resources. Starting from the uncontrolled growth of the farming land and the establishment of oil fields in the desert, that has caused the demand for water to exceed the natural supply available, therefore leading to the engineering of water supply infrastructures with a tremendous outcome on the environment. Numerous rivers have dried out in the course of the past 100 years because of their deviation, which has caused the disappearance of small oases and lakes: (in)famous is the disappearance of the Lop Nor lake, a clear backlash of the human interventions. But the apex of the exploitation was witnessed with the 50 years of nuclear tests executed in the north-east of the basin, which have unavoidably destroyed the ecosystems and the natural stability of the area.
The act of extreme exploitation carried over the land consequently creates discontinuities in its surface, disorder in the ecosystems and incongruity in its structure. What is perceived by the eye, the remaining of the land along with the actions performed on it, does not 'make sense' anymore.

It would be overly simplistic to only focus on the appearance and the exploitation acted on the terrain. What lies behind an absolute de-territorialization, and the consequent dis-integration of the territory, is rooted much deeper within the meaning of it.
What is to be learnt by ears from the recent history of the region is entirely shaped by disputes, violence, repressions and destruction. Starting from the 1960s, the Xinjiang province has witnessed an increasing number of Han Chinese migrating to the area, which has led to several riots and violence exploding at the beginning of the 20th century, due to the claims of disparities in opportunities and treatment between different ethnic groups. In an attempt to avoid further violence and attacks (like the Urumqi riots of 2009), the Chinese Communist Party has been forcing an agenda of re-education and de-extrimification of thoughts. Claiming that the tendencies towards 'terrorist' (as per their definition) and independency ideals lie within the local uprising and culture in general, the program has focused on a cultural saturation (even to the point of erasure) at a concrete level, being carried via the demolition of heritage as well as the 'disneyfication'[9] of specific areas in order to enhance tourism. This 'urbanicide' has affected traditional cemeteries, being replaced by 'more hygienic' ones, and Mosques, being de-domed, or even demolished, because regarded as dangerous or not legitimate. More disputed is the debate over the re-education centers' infrastructure which was introduced to educate

[5] Deleuze, G., Guattari, F., (1987). A Thousand Plateaus: Capitalism and Schizophrenia (2nd ed.). University of Minnesota Press.
[6] Ibid.
[7] Ibid.
[8] Deleuze, G. (2005). Pure Immanence (2nd ed.). Zone Books.
[9] Kehoe, A. (1991). Christian contradictions and the world revolution: Letters to my son. Glendale

the local population to the Chinese traditions and culture, but instead there are claims that these are nothing more than detention centers acting to culturally brainwash its prisoners; allegations that the government of China has repeatedly disregarded and denied. Different is the case of the concept of the 'disneyfication', a process of renewal and upgrade of potential touristic sites, where the culture is appropriated rather than erased in order to elevate it to an economic benefit for the country. It creates a reality resembling Disneyland. Destroying the truthful reality and leaving a cardboard cutout of the previous territory. What we see is therefore undermined, is fake but it still aims at resembling the prior existence. We become aware of it only by the sense of place being altered.
If the meaning of a territory is directly related to its traditions, exploiting the culture means detaching it from the agency of its routes, and it becomes an act of de-territorialization as a mean to achieve security, profit and ultimately control. An act that abruptly deprives the territory of its essence and nuances.

We could already talk about a 'death' of a territory once its characters and meanings are lost as a consequence of this process, but it would only be a 'partial death' since we would still rely on the memory of it, letting the territory 'live' through the imagination, through the people, its people.
The notably disputed crisis of the Uighurs minority is the epitome of the exploitation of people. Witnesses and leaked documents support the theory of a possible enforcement of labor over the Muslim population of the Xinjiang province, beside the aforementioned allegations of mass incarceration within the 'de-extrimification camps'. If we were only to focus on the publically stated intensions for these 're-education centers', leaving aside allegations, we would still be talking about a clear intention to homogenize the culture of the area with the Han Chinese traditions and habits over the different ethnic groups. Creating this forced homogeneity of people stand to lose completely the territory, and the memory of it by forcing, in this case, a re-territorialization of thoughts.

The combination of such processes unavoidably leads the territory to a 'plane of immanence', an undefined state that I hereby tried to connote as the death of it. An irreversible death from all possible aspects, tangibles and non: deconstructing its characteristics, altering its meaning and replacing its memory.
Once all the processes of de-territorialization are completed, the permanent changes to the territory leave nothing but a dying land, with no culture and a homogenized population that can only spectate to this horrific play of destruction. Little to no opportunities remain for the people, spectators as well as passive actors to the act, in a suggestive new role for them to discover, a new land to re-appropriate and a culture to rebuild.

Filippo Testa

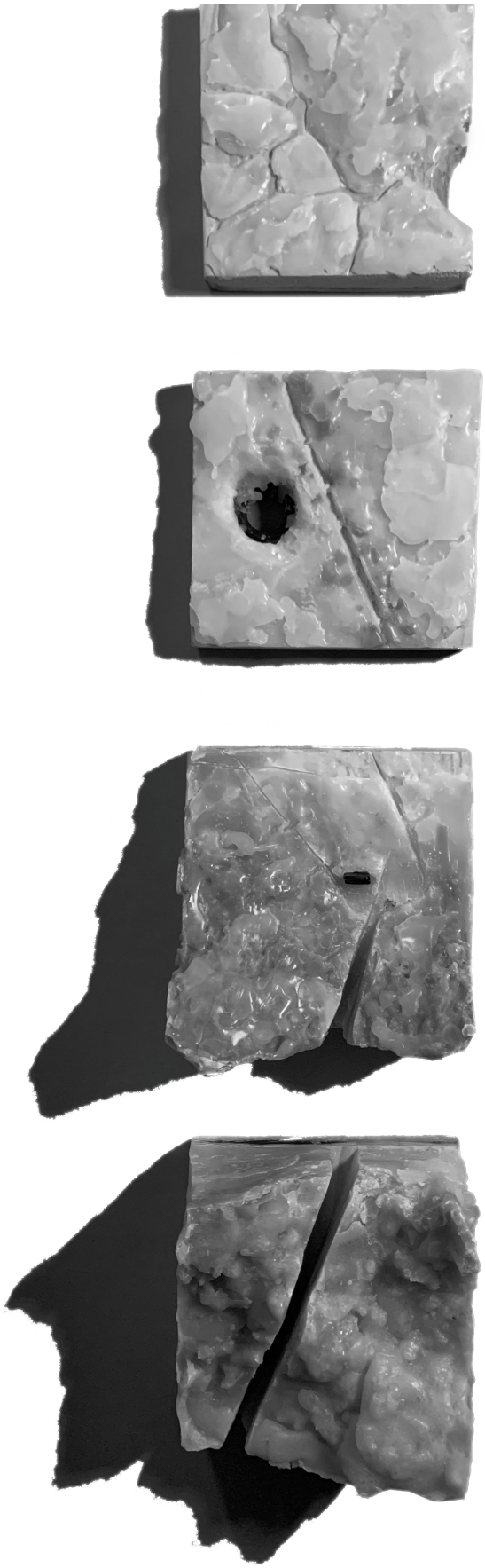
[10] Debord, G. (2002). Society of The Spectacle. Black & Red.

Bibliography:

1. Deleuze, G., Guattari, F., (1987). A Thousand Plateaus: Capitalism and Schizophrenia (2nd ed.). University of Minnesota Press.
2. Deleuze, G. (2005). Pure Immanence (2nd ed.). Zone Books.
3. Jacobs, J. (1992). The Death and Life of Great American Cities (Reissue ed.). Vintage.
4. Walter, E. (1988). Placeways: A Theory of the Human Environment (Illustrated ed.). University of North Carolina Press
5. Debord, G. (2002). Society of The Spectacle. Black & Red.
6. Foucault, M. (1994). Security, Territory, Population, 1977-78: 1st (First) Edition (7254th ed.). Palgrave Macmillan.
7. Kehoe, A. (1991). Christian contradictions and the world revolution: Letters to my son. Glendale.

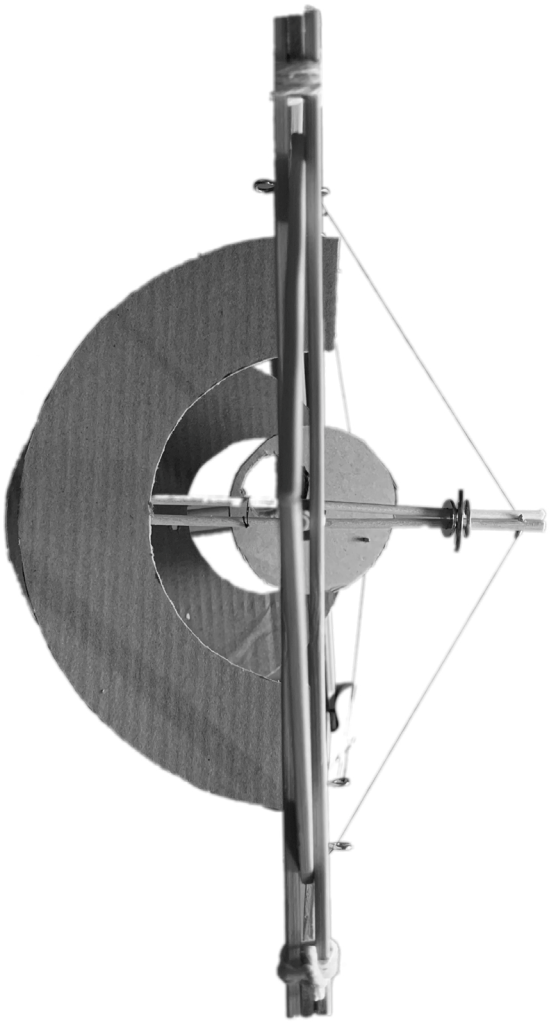
Condition of the Land

Exploitation discontinuity within the territory.



Condition of the People

Spectacle and spectators.



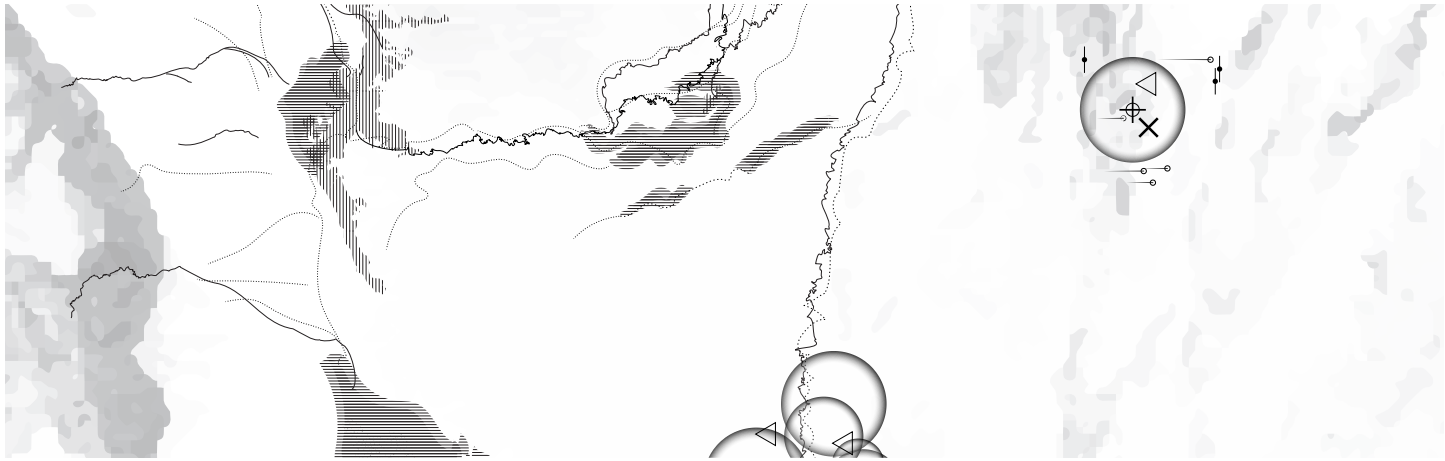
Condition of the Unseen

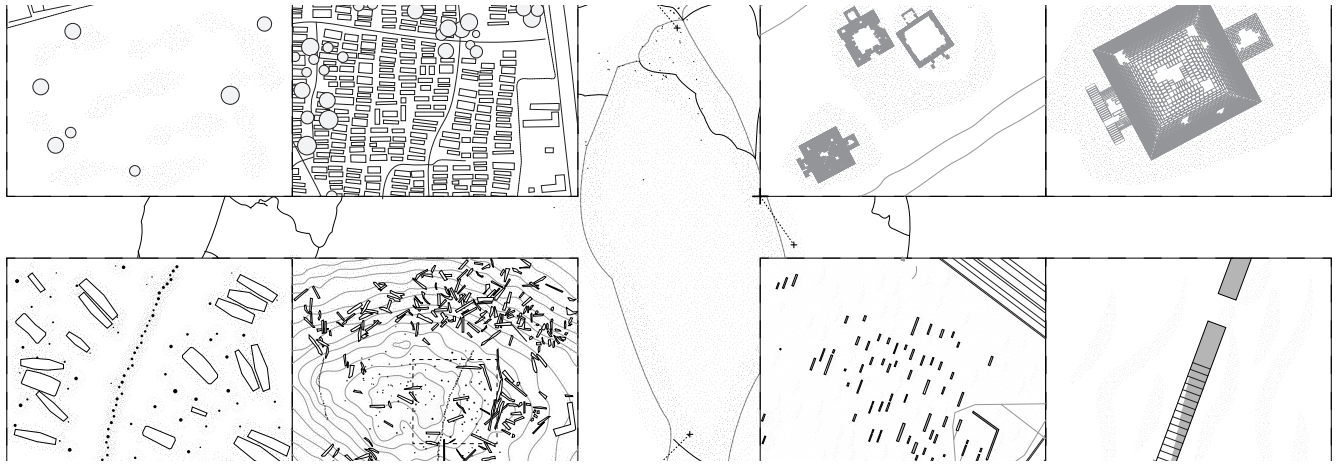
Blurred spectacle and secrets.

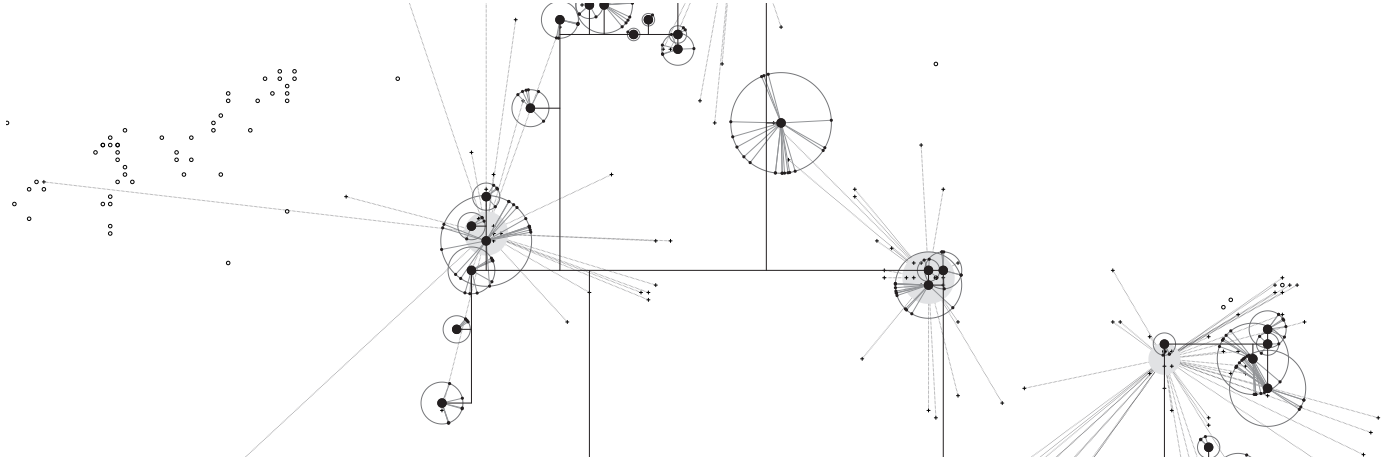
Research: Death of a Territory

The integrity of the Xinjiang region has been deeply destabilized from its core over the past 50 years. The research aimed at unraveling the causes that have led to a territorial decline, which happened through the acute exploitation of land, culture and people.

Such acts, when layered one over the other, lead to an *absolute exploitation* of the territory. An absoluteness that leaves no escape, no salvation. These was defined by reinterpreting Foucault's notion of absolute de-territorialization. The definition of such went as far as describing how the absolute exploitation leads, through the disappearance of heritage, ecosystems, land, traditions and people, to an unprecedented **death of the territory** as it once was. Deprived of its land, of its culture and of its society / people, the Tarim Basin can be therefore regarded as dead.



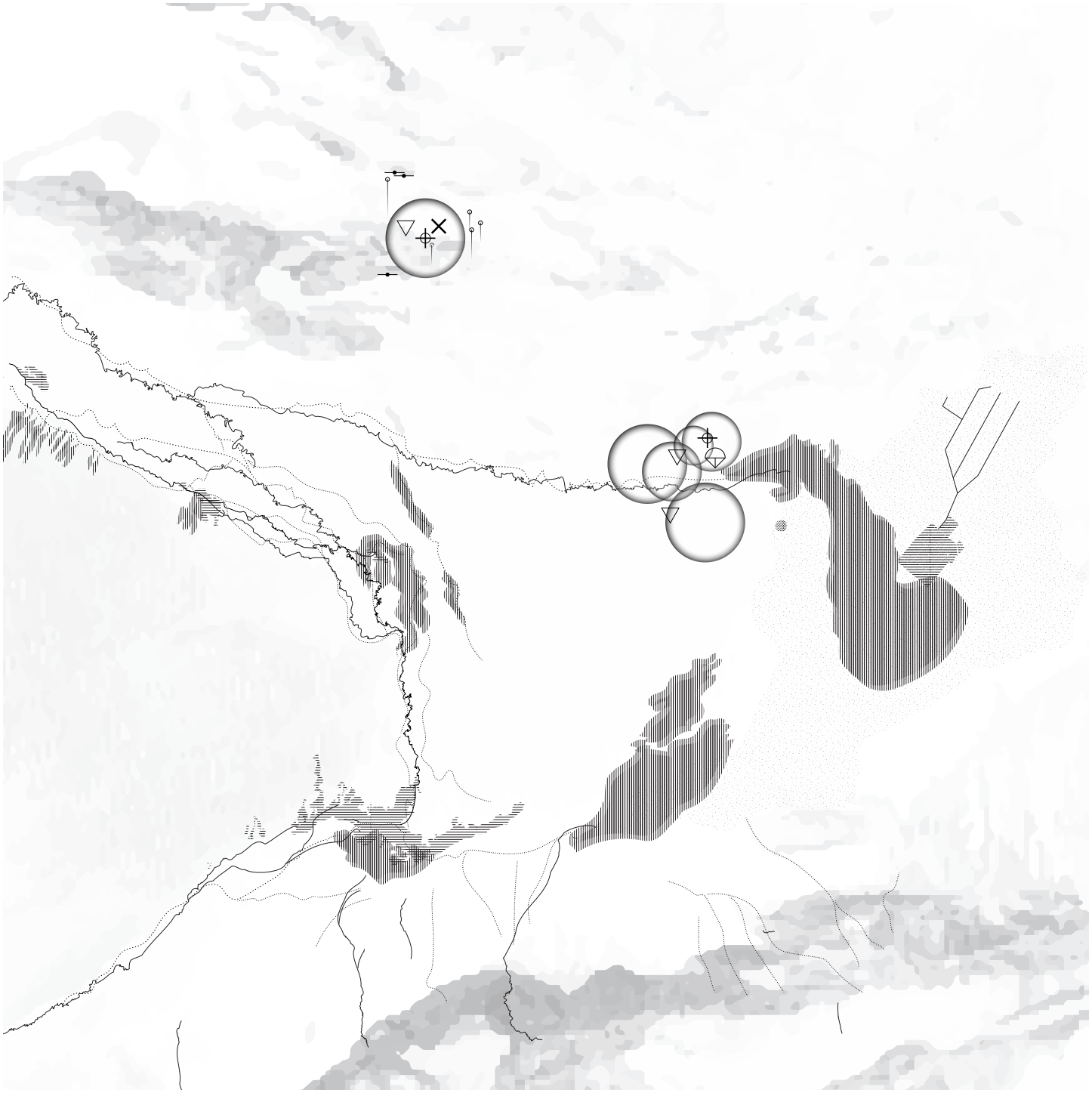




Exploitation of the Land

Starting from the uncontrolled growth of the farming land and the establishment of oil fields in the desert, that has caused the demand for water to exceed the natural supply available, therefore leading to the engineering of water supply infrastructures with a tremendous outcome on the environment. Numerous rivers have *dried out* in the course of the past 100 years because of their deviation, which has caused the *disappearance* of small oases and lakes: (in) famous is the disappearance of the **Lop Nor** lake, a clear backlash of the human interventions.

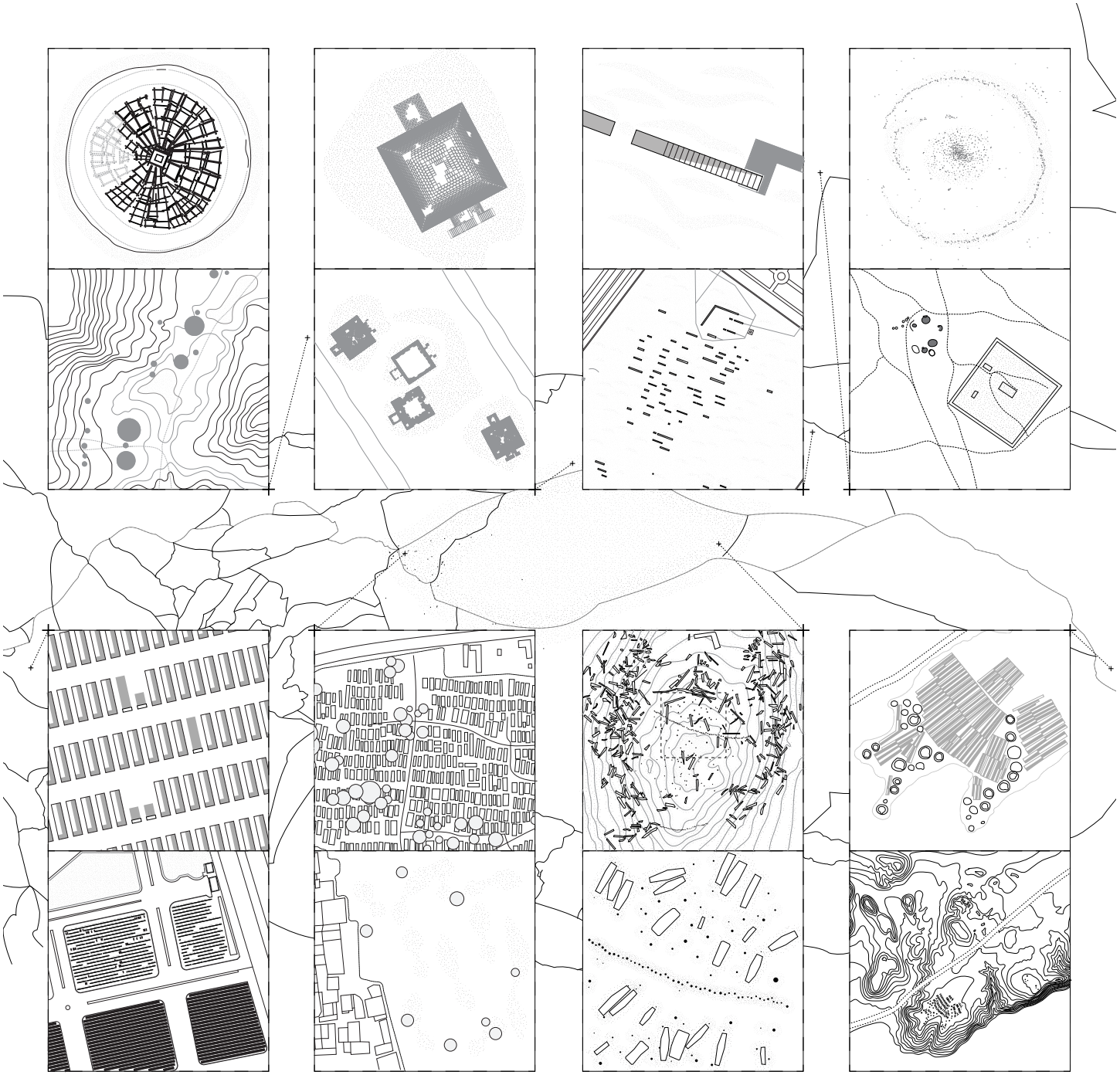
The apex of the exploitation was witnessed with the 50 years of **nuclear tests** executed in the north-east of the basin, which have unavoidably destroyed the ecosystems and the natural stability of the area.



Exploitation of the Culture

The recent history of the region is entirely shaped by disputes, violence, repressions and destruction. The mass migration of Han has led to several riots and violence exploding at the beginning of the 20th century. In an attempt to avoid further violence and attacks the Chinese Communist Party has been forcing an agenda of *re-education and de-extremification* of thoughts.

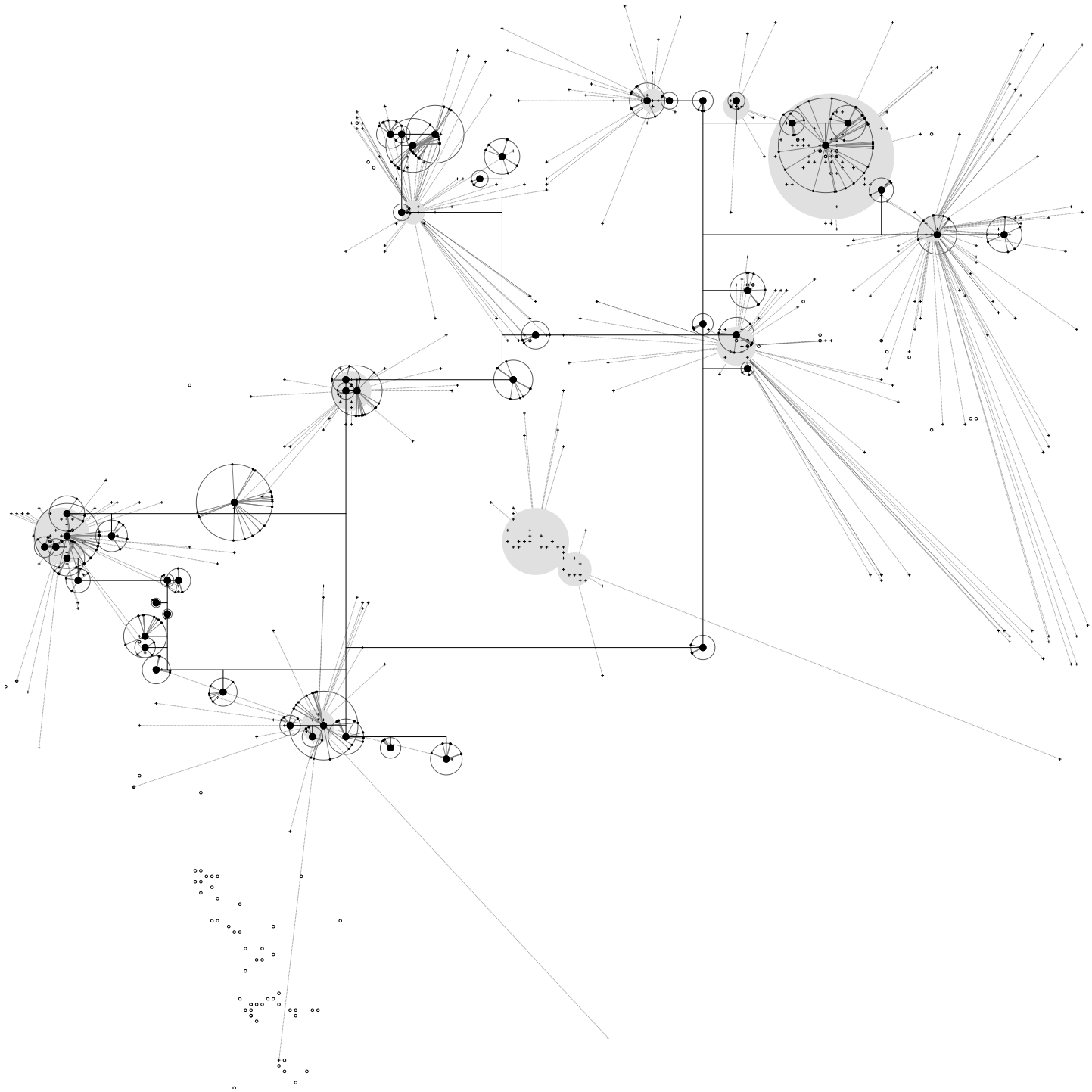
A **cultural saturation** (even to the point of **erasure**) at a concrete level, being carried via the demolition of heritage as well as the '*disneyfication*' of specific areas in order to enhance tourism. This '*urbanicide*' has affected traditional **cemeteries**, being replaced by 'more hygienic' ones, and Mosques, being de-domed, or even demolished, because regarded as dangerous or not legitimate.



Exploitation of the Bodies

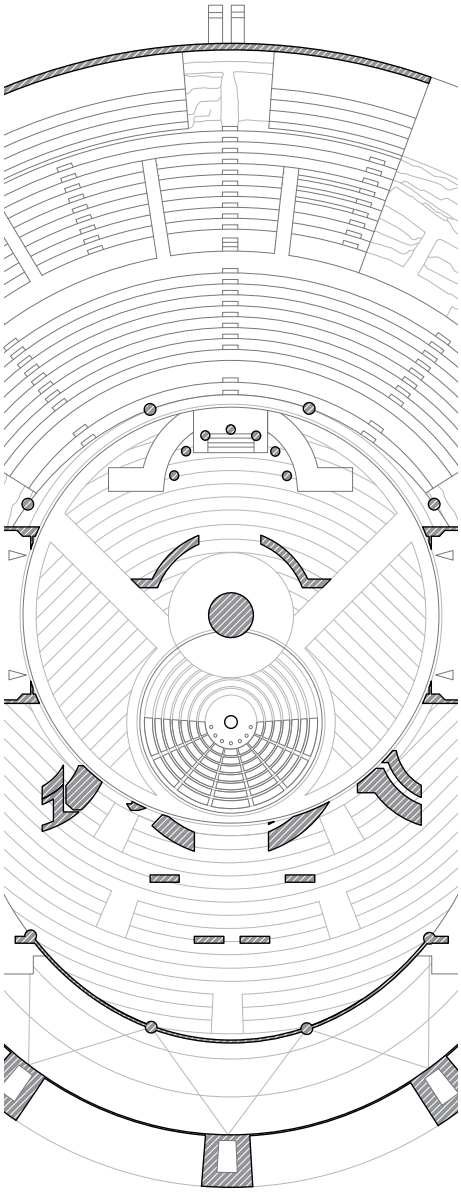
The notably disputed crisis of the **Uighurs minority** is the epitome of the exploitation of bodies. Witnesses and leaked documents support the theory of a possible *enforcement* of labor over the Muslim population of the Xinjiang province, beside the aforementioned allegations of mass incarceration within the **'de-extrimification camps'**.

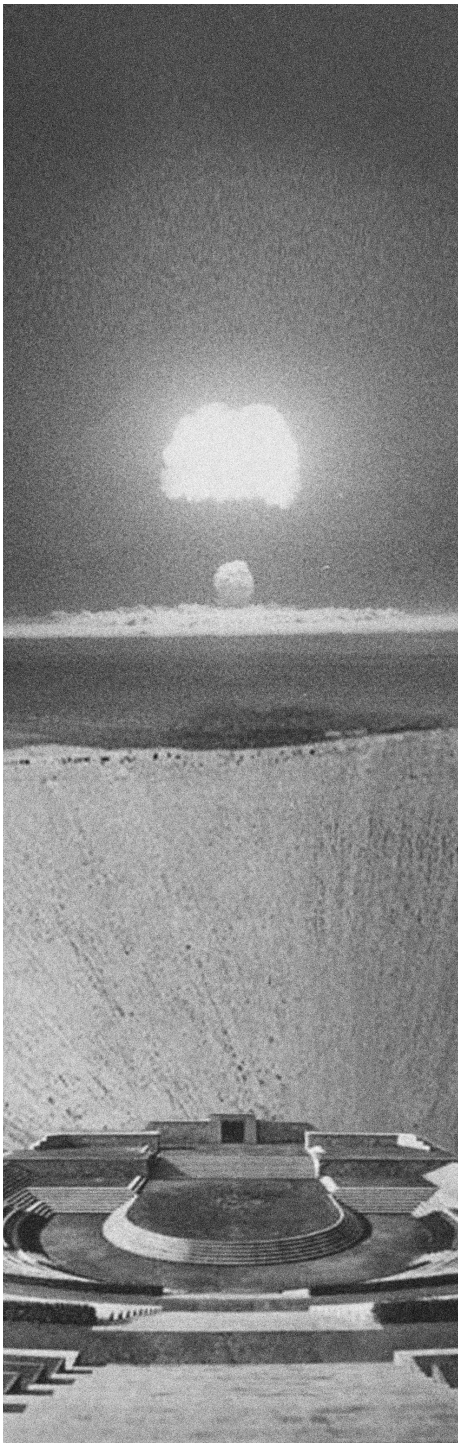
If we were only to focus on the publicly stated intensions for these 're-education centers', leaving aside allegations, we would still be talking about a clear intention to homogenize the culture of the area with the Han Chinese traditions and habits over the different ethnic groups. Creating this forced **homogeneity** of people stand to lose completely the territory, and the memory of it by forcing, in this case, a re-territorialization of thoughts.



Proposal

The architectural proposition aims at understanding the condition of the territory, at approaching its death initially by grieving it. Secondary it will be a means of re-owning, re-appropriating the land from the point of view of the Uighurs minority, which has been previously deprived of it.

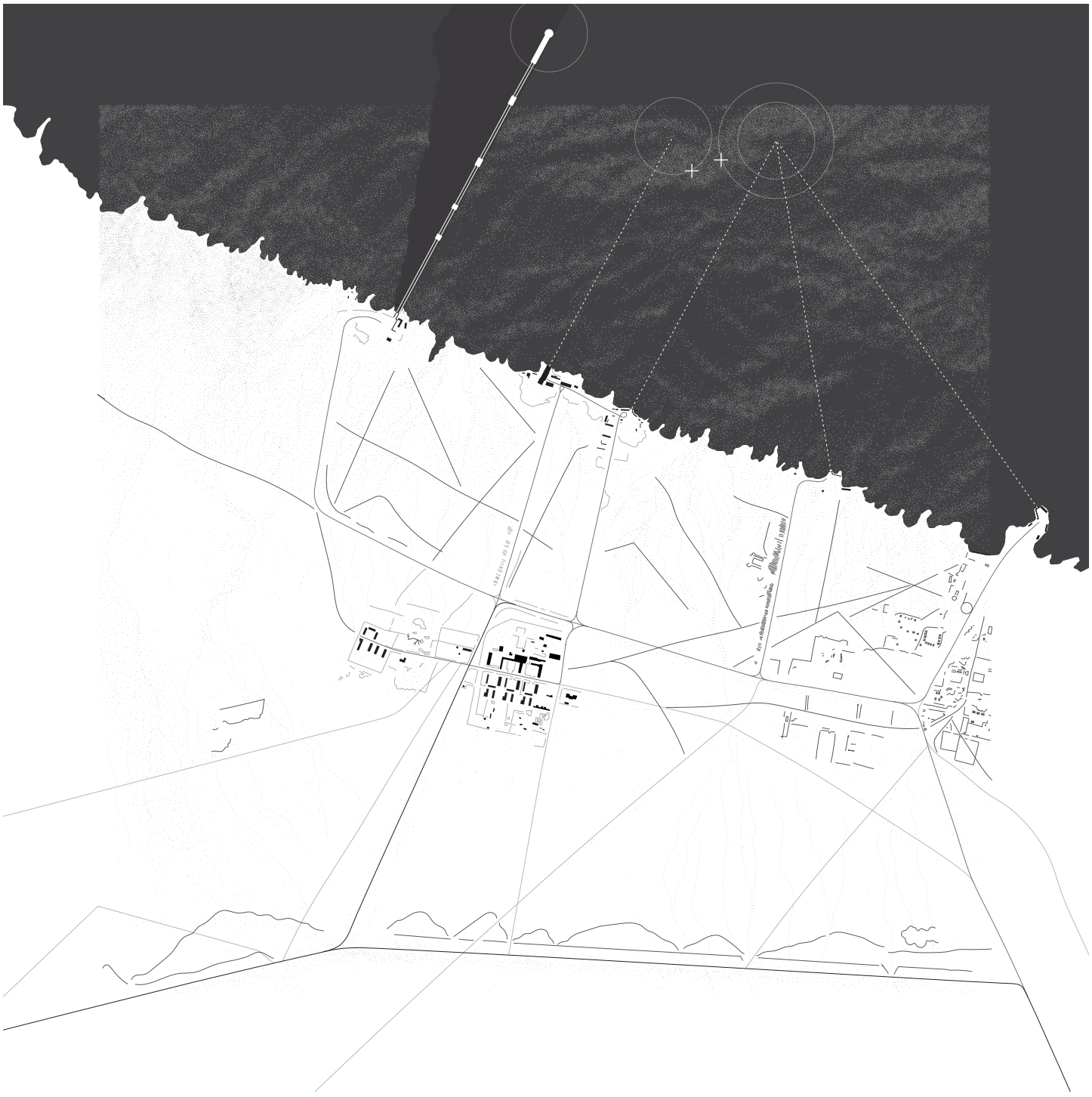




Site Approach: Nuclear

As a follow up to the research over the 'exploitation' of the Tarim Basin the site landed in the area which represents the apex of the destruction of the land: the nuclear tests bases.

The whole region has been 'punctured', 'cut' and 'blown up' during a 50 years long period of testing which has left the land in a very extreme and discontinuous state. The 'scars' in the ground, the 'corpses' of the abandoned facilities are just the superficial forensic features of the destruction of the area. Underneath the ground lie tunnels, holes, radioactive soil and a very complicated reality which makes this the perfect spot for an initial approach to the 'death of a territory' and its grieving.



Artifact
Spectators - Passive Actors

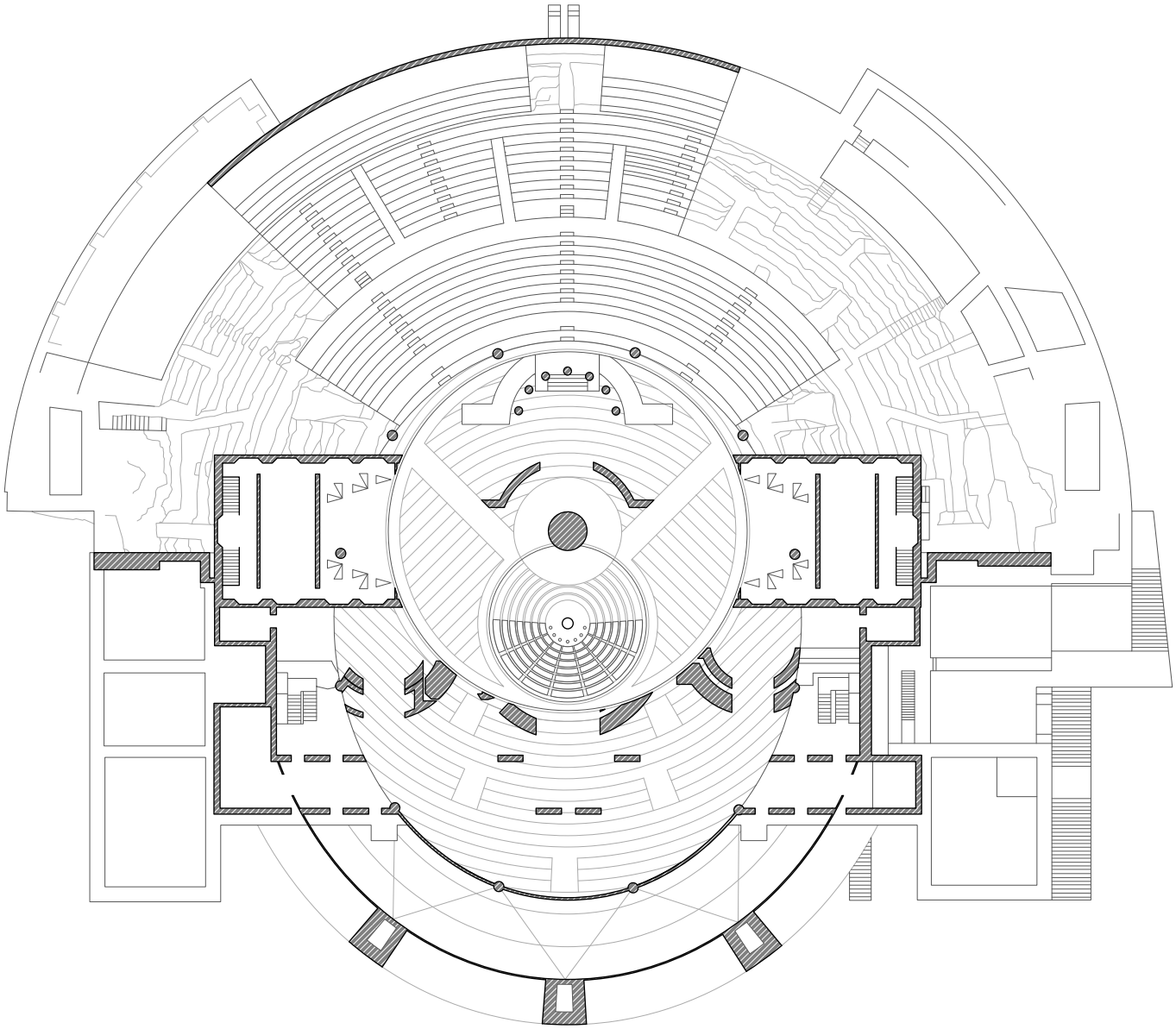
By drawing an analogy with Guy Debord 'Society of the Spectacle' we could define the Uighurs minority as the spectators of the 'Death of the Territory' play which is acted upon the Tarim Basin. Witnesses and spectators to the destruction of the land that they once used to own.

But being an exploited commodity, their role is much more complex than the one of mere spectators, and the theatrical set comes useful as an analogy to unravel their reality.

The use of study models and formal exercises over a new typology of a theatre where roles can shift, has helped in the deeper understanding of the analogy of the spectacle with the Tarim reality, using famous theatrical theories such as Furttenbach machinic theatre, Camillo's theatre of the memory and Gropius total theatre.

If landed within the traditional environment of a theatre, the reality of the Muslim minority, as said, would be to sit in the stalls and spectating at a play which is happening over the stage, where the territory is the background and the Bingtuan (or Chinese political agenda) is the main actor. These highlighting the duality of this set.

The reality is very different from this though, and I tried to explain it with a new understanding of the roles in this theatrical set. In fact, the spectators are here placed in the middle of the stage, becoming part of the play and part of the territory, so part of the background. The actors are no more in clear site but they rather stand in the backstage 'puling the ropes' that cause the stage to move, change and therefore they are manipulating the territory and the people in it.

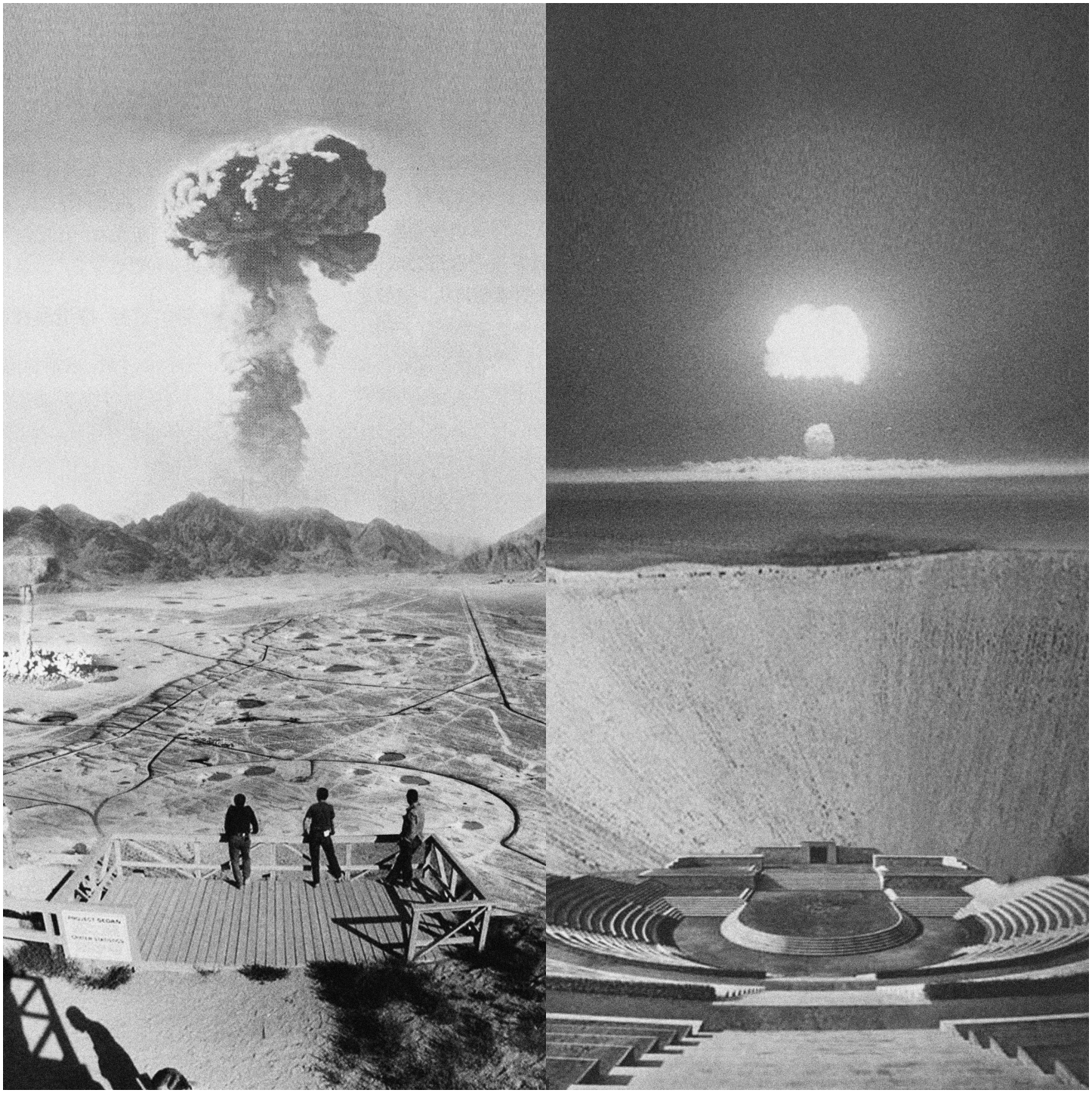


Mirage:
Architectural Proposition

The project intends to serve as a act to rebuild the territory by reversing the process of death.

The architecture will utilize the destructions in order to *acknowledge* them, to reveal them, to enable the overlooking of them by situating itself in the destruction, in the facilities, in the corpses left by the process of killing the territory.

Ultimately it will also serve as a medium to not only spectate but also gather and rebuild the territory, setting a *rebirth* of the land, of the culture and, at last, of the people.



Final Reflections

On individual and collective research

Filippo Testa

Oasis Cities. *Qiaoyun Lu*
The Border and Territory map presents our generalized concept of Tarim Basin while in the second map each of us indicates our own interest of the region. I am quite fascinated by the oasis cities in Xinjiang, which are geomorphologically enclosed, geographically dispersed, and ecologically fragile. By studying the catalogue of oasis cities in Xinjiang, I found the urbanization mode there is weakening the relationship between cities and the landscape. The redevelopment project in Kashgar replaced the mud buildings with concrete ones and at the same time caused a huge impact to Uygur culture. The study of oasis cities reflects both the geographical condition and systematical context in Xinjiang, contributing to comprehensive understanding of the terrain and also helping me form my own project.

Absolute exploitation. *Filippo Testa*
The collective focus over the generalized exploitation of the Tarim Basin allowed me to highlight the anomalies happening within its borders. In the index map is visible the level of the exploitation, with the extreme example of the nuclear tests carried in the north-eastern side of the basin, as well as the consequences brought from this process: The Lop Nor example stands as the clearest backlash of human intervention. The lake, here visible on the first slice, has been described through history as a wandering body, changing its shape and size during the seasons and being an incredible resource for the oases around it. All that remains of the lake, which is now dried out due to the deviation of water courses in an effort to supply crop farming and resource extractivism, is an engineered potash farming land, pictured here.

Through the mappings of these anomalies I arrived at the delineation of three main lines of exploitation: exploitation of the land, exploitation of the culture and exploitation of the bodies. Tri-partition that sits as a base for the analytical understanding of the condition of the territory and also for the theoretical framework given to the condition of the society.

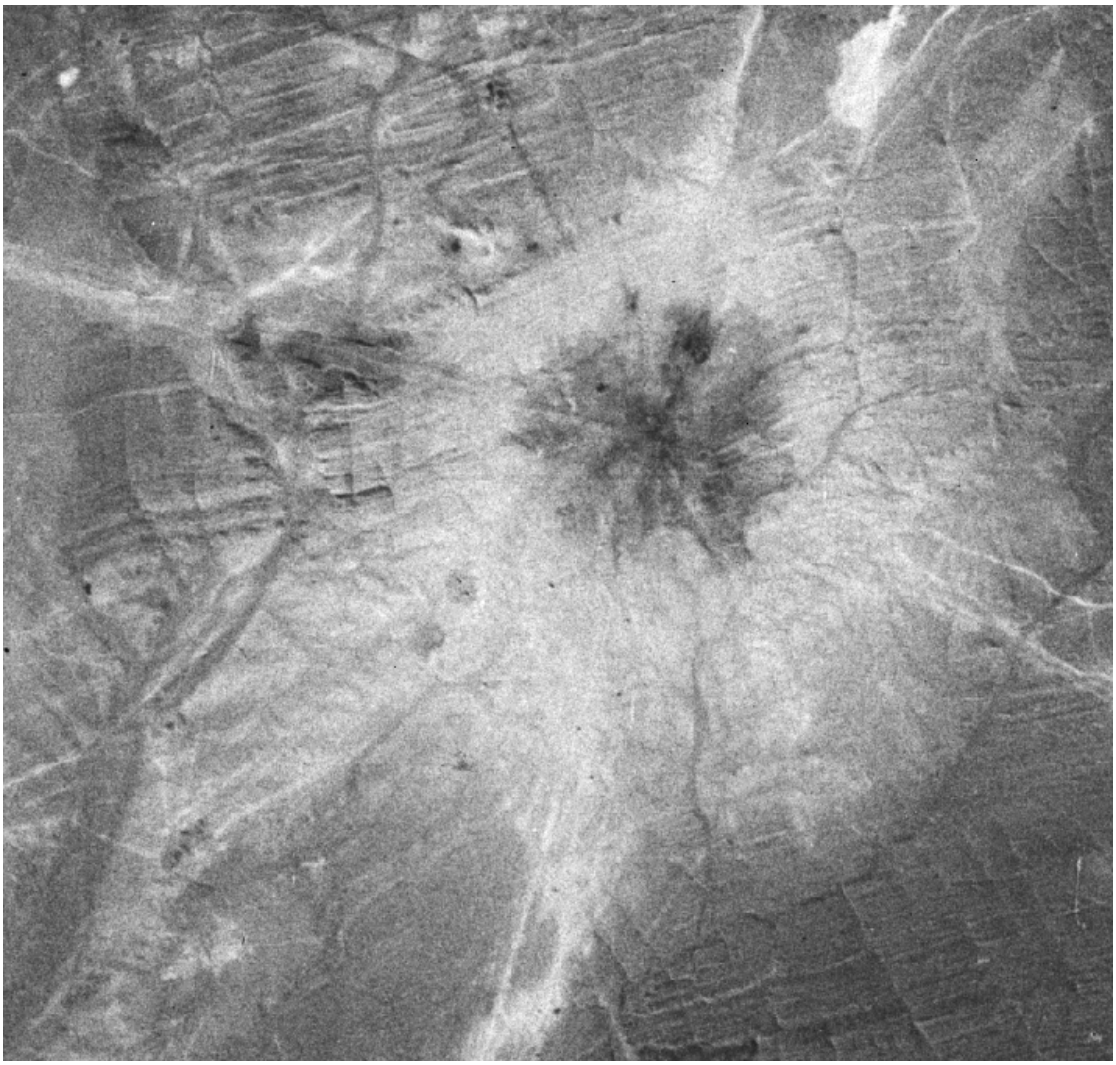
Water as a lens. *Katherina WeiWei Bruh*
The exercise of classifying what border conditions from territory was useful for my research. It showed how water was a border condition. But trying to map it, I saw the need to delineate a difference between what was man made and what was ephemeral. This allowed us to see the expansion of oasis towns beyond their periphery by using water as a lens. According to urbanist Matthew Gandy water is "a brutal delineator of social power which has at various times worked to either foster greater urban cohesion or generate new forms of political conflict'. Indeed in the desert landscape of Xinjiang, these issues are amplified. Thus, water can reveal dispositions, clues knitted into the urban tapestry as it is extracted, stored, manipulated, commodified and privatised. Fed by glaciers in the Tianshan Mountains, this source of freshwater traverses across the length of the region flanking the desert bowl before drying up in the endorheic basin. Revealing with it a system of oasis towns and their eternal dependency on the Tarim River. By discerning the difference between natural and man-made flows, we can see how oases have expanded far beyond their original footprints and natural limits which thus informed my project.

Hidden gems. *Mine Çelik*
During the research I have computed all of the indicators and found that the growth of the mineral resources industries is strongly correlated with economic and urban development. I found significant exploitation variations in the relationship and trend of geographical concentration. Which helped me to understand the ongoing opportunities and challenges of the Xinjiang province. I also found strong evidence to support the argument that mineral exploitation has an impact on industrial specialization, which guided me on how to take advantage of the large-scale development of mineral resources exploration for my project.

Discourse analysis. *Matthew Touzet*
The current crisis of the COVID-19 pandemic has exacerbated the already encroaching blend of the digital and physical realms. These changes have made a large impact on researchers by forcing us to rely on the Internet and search engine results. This academic dilemma, coupled with the encroachment of surveillance capitalism on the privacy and independence of individuals, became the point of departure in my research.

Nuclear

Filippo Testa



Intro

Nuclear Imperialism-Necropolitics Nexus

Alexis-Martin 2019

"The aftermath of nuclear imperialism in Lop Nor is well explained by Mbembe's theory of necropolitics (Mbembe 2003). The actions of the PRC in its control and subjugation of Uyghur people can be well described by his description of "weapon are deployed in the interest of maximum destruction of persons and the creation of 'death-worlds'…", referring to a 'phantom-like' form of existence in which vast populations are subjected to the power of the state over their life and death. He also writes that "the extraction and looting of natural resources by war machines goes hand in hand with brutal attempts to immobilise and spatially fix whole categories of people" or even "to unleash them, to force them to scatter over broad areas no longer contained by the boundaries of a territorial state" (Mbembe 2003, pg., 34), which aptly portrays some of the impacts of PRC exploitation of Xinjiang, and it's subjugation of the people who live there. Necropolitics, therefore, provides the theoretical tools to understand the conditions that are imposed upon those who were exposed to contamination or forced to flee their homes, due to the Lop Nor nuclear weapon tests.

Through the nuclear activity across Xinjiang, the sovereignty power of the PRC has dominated and racialized Uyghur environments, culture and bodies.

The exclusion of Uyghur people from state acceptance has been robustly depicted as an expression of Foucault's biopolitics, whereby this community symoolizes an almost biological threat to Chinese society that must be managed by surveillance, punishment, and detention (Foucault 1997; Roberts 2018). I argue that the threats that the PRC perceives in Xinjiang are not just cultural, but also economic and political, and its actions against Uyghurs are distinctively necropolitical."

Table of Contents

Context

Lop Nor Nuclear Testing Base

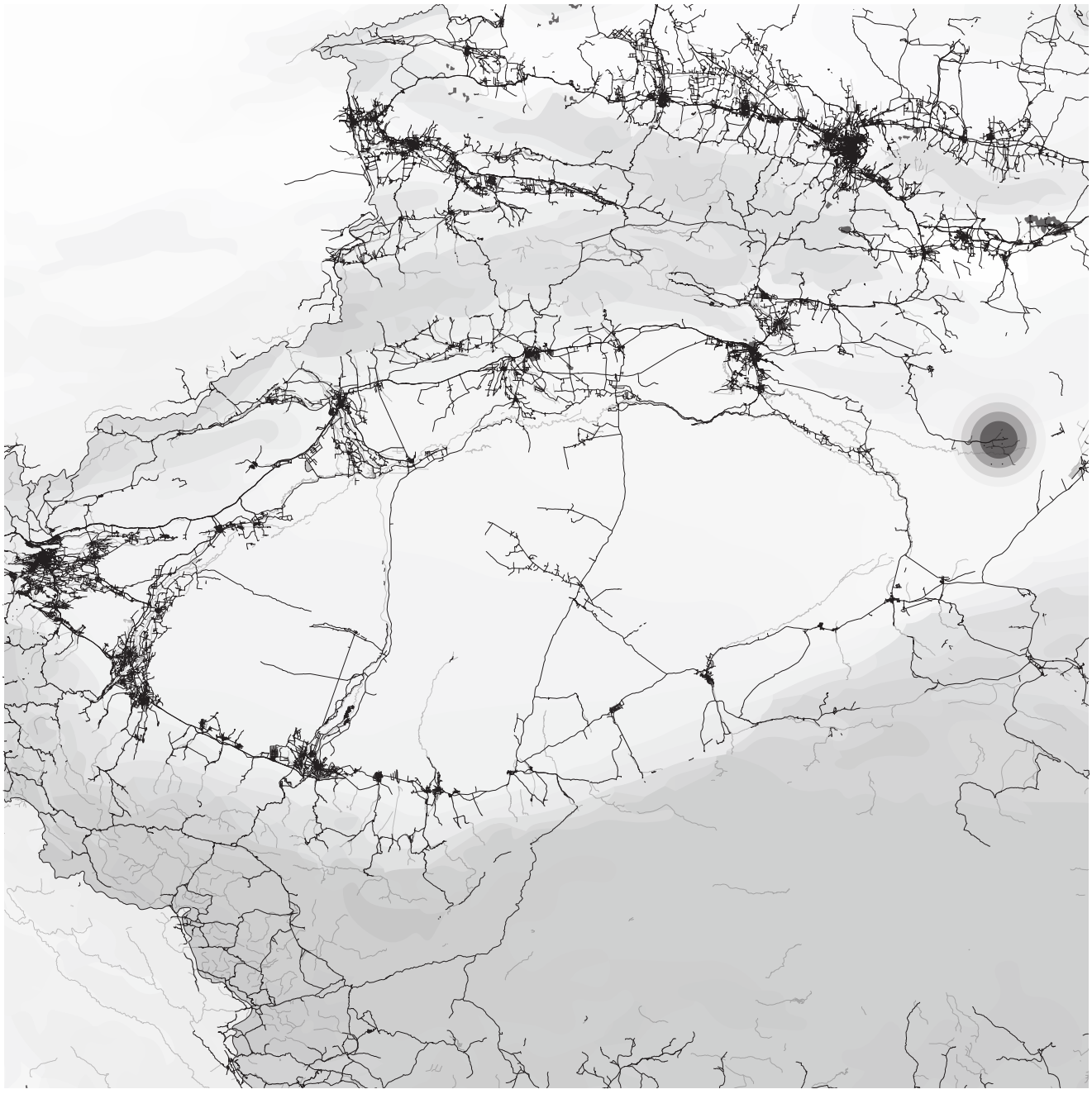
"All that once was directly lived has become mere representation."

"the decline of being into having, and having into merely appearing."

"historical moment at which the commodity completes its colonization of social life."

Guy Debord - Society of the Spectacle

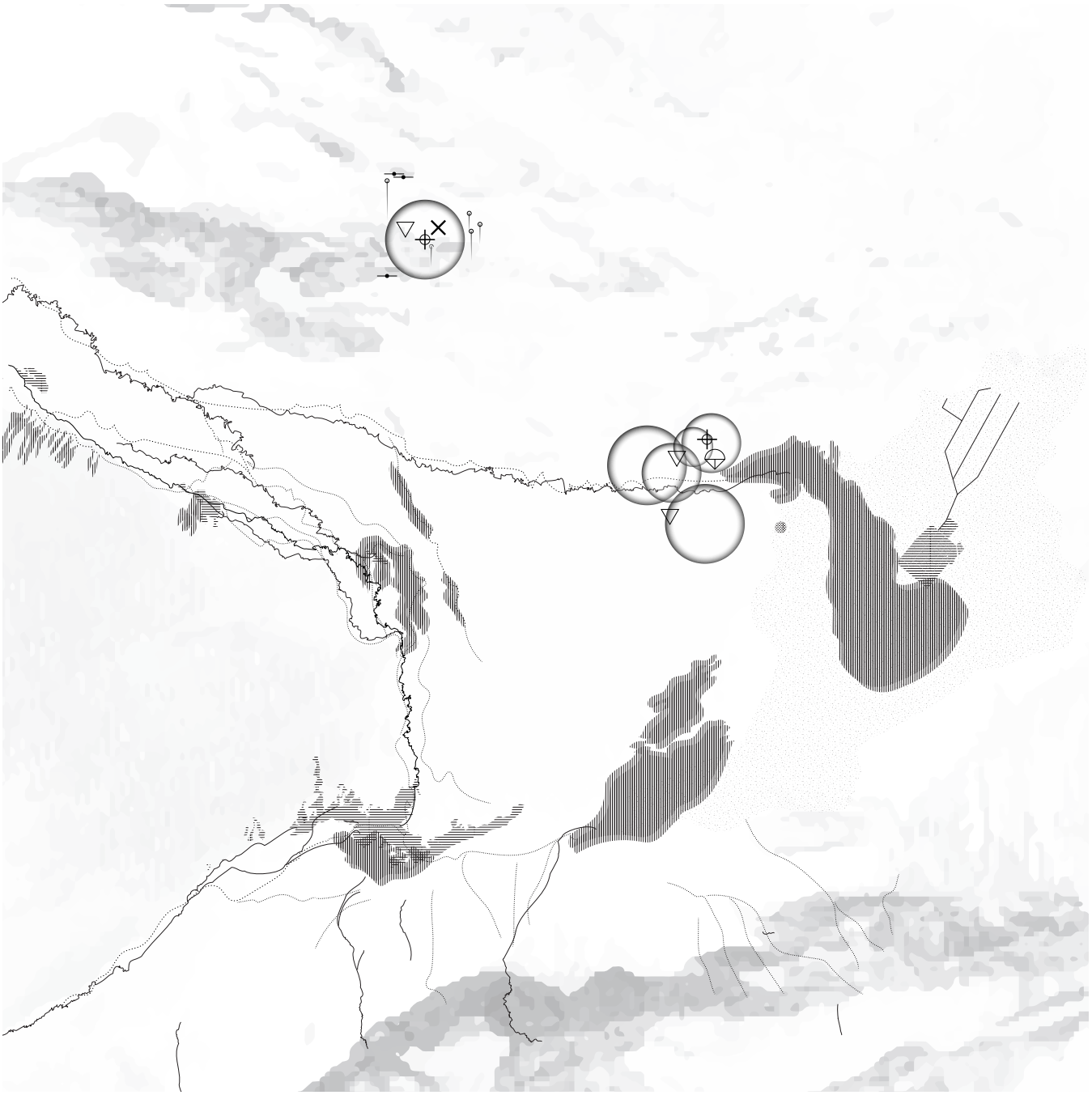
Lop Nor Base location



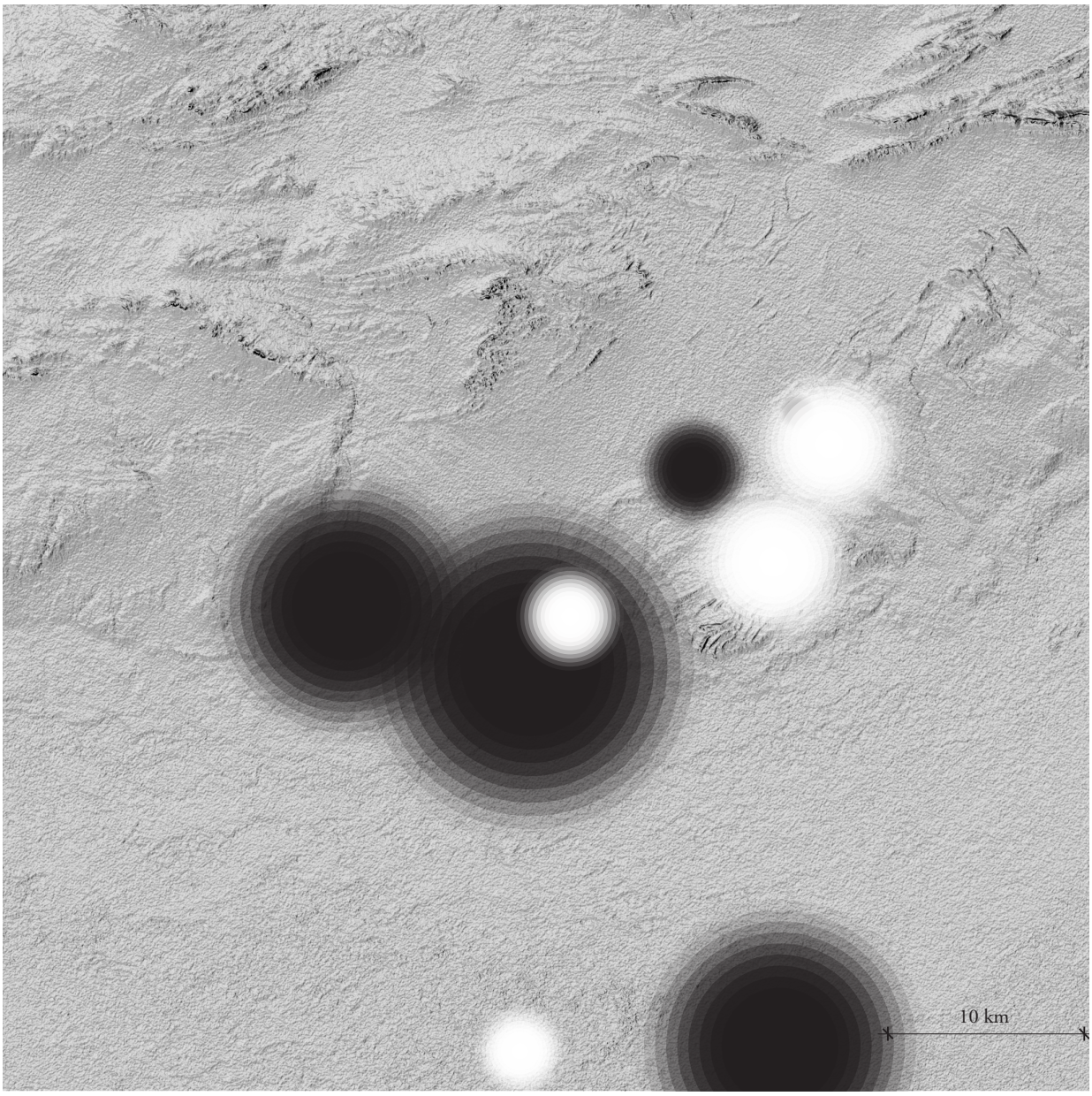
Exploitation of the Land

Starting from the uncontrolled growth of the farming land and the establishment of oil fields in the desert, that has caused the demand for water to exceed the natural supply available, therefore leading to the engineering of water supply infrastructures with a tremendous outcome on the environment. Numerous rivers have *dried out* in the course of the past 100 years because of their deviation, which has caused the *disappearance* of small oases and lakes: (in) famous is the disappearance of the **Lop Nor** lake, a clear backlash of the human interventions.

The apex of the exploitation was witnessed with the 50 years of **nuclear tests** executed in the north-east of the basin, which have unavoidably destroyed the ecosystems and the natural stability of the area.

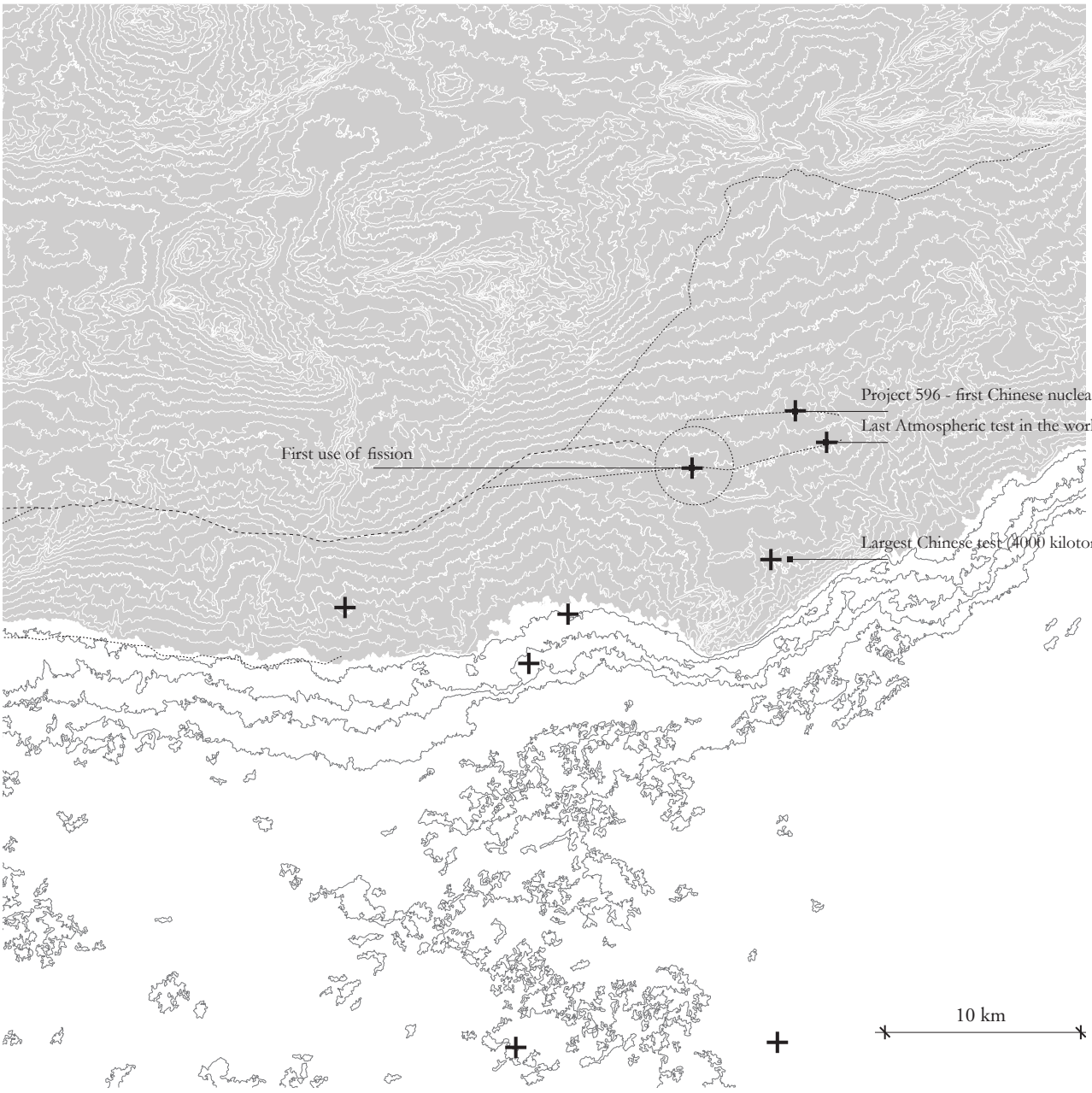


Project 596	16/10/64	D	Tower		22
CHIC-2	14/05/65	D	Air drop		35
CHIC-3	09/05/66	D	Air drop		250
CHIC-4	27/10/66	D	High alt rocket	12	
CHIC-5	28/12/66	D	Tower		300
CHIC-6	17/06/67	D	Parachuted		3300
CHIC-7	24/12/67	D	Air drop		20
CHIC-8	27/12/68	D	Air drop		3000
CHIC-9	22/09/69	B	Tunnel		19
CHIC-10	29/09/69	D	Air drop		3000
CHIC-11	14/10/70	D	Air drop		3400
CHIC-12	18/11/71	D	Cratering		20
CHIC-13	07/01/72	D	Air drop		8
CHIC-14	18/03/72	D	Air drop		170
(15)	27/06/73	D	Air drop		3000
(16)	17/06/74	D	Atmospheric		1000
(17)	27/10/75	B	Tunnel		3
(18)	23/01/76	D	Atmospheric		N/A
(19)	26/09/76	D	Atmospheric		200
(20)	17/10/76	A	Tunnel		3
(21)	17/11/76	D	Air drop		4000
(22)	17/09/77	D	Atmospheric		N/A
(23)	15/03/78	D	Atmospheric		11
(24)	14/10/78	C	Underground		3
(25)	14/12/78	D	Atmospheric		N/A
Failed	02/02/79	D	Underground		1
(26) aborted	13/09/79	D	Parachuted		N/A
(27)	16/10/80	D	Atmospheric		1000
(28)	05/10/82	D	Underground		7
(29)	04/05/83	A	Tunnel		1
(30)	06/10/83	C	Underground		N/A
(31)	03/10/84	C	Underground		N/A
(32)	19/12/84	A	Tunnel		15
(33)	05/06/87	C	Underground		250
(34)	29/09/88	A	Tunnel		3
(35)	26/05/90	C	Underground		N/A
(36)	16/08/90	C	Underground		189
(37)	21/05/92	C	Underground		660
(38)	25/09/92	A	Tunnel		8
Failed	02/11/92	D	Underground		1
(39)	05/10/93	C	Underground		80
(40)	10/06/94	C	Underground		90
(41)	07/10/94	C	Underground		90
(42)	15/05/95	C	Underground		95
(43)	17/08/95	C	Underground		90
(44) - 1	08/06/96	C	Underground		50
(44) - 2	08/06/96	C	Underground		N/A
(45)	29/07/96	A	Tunnel		3


10 km

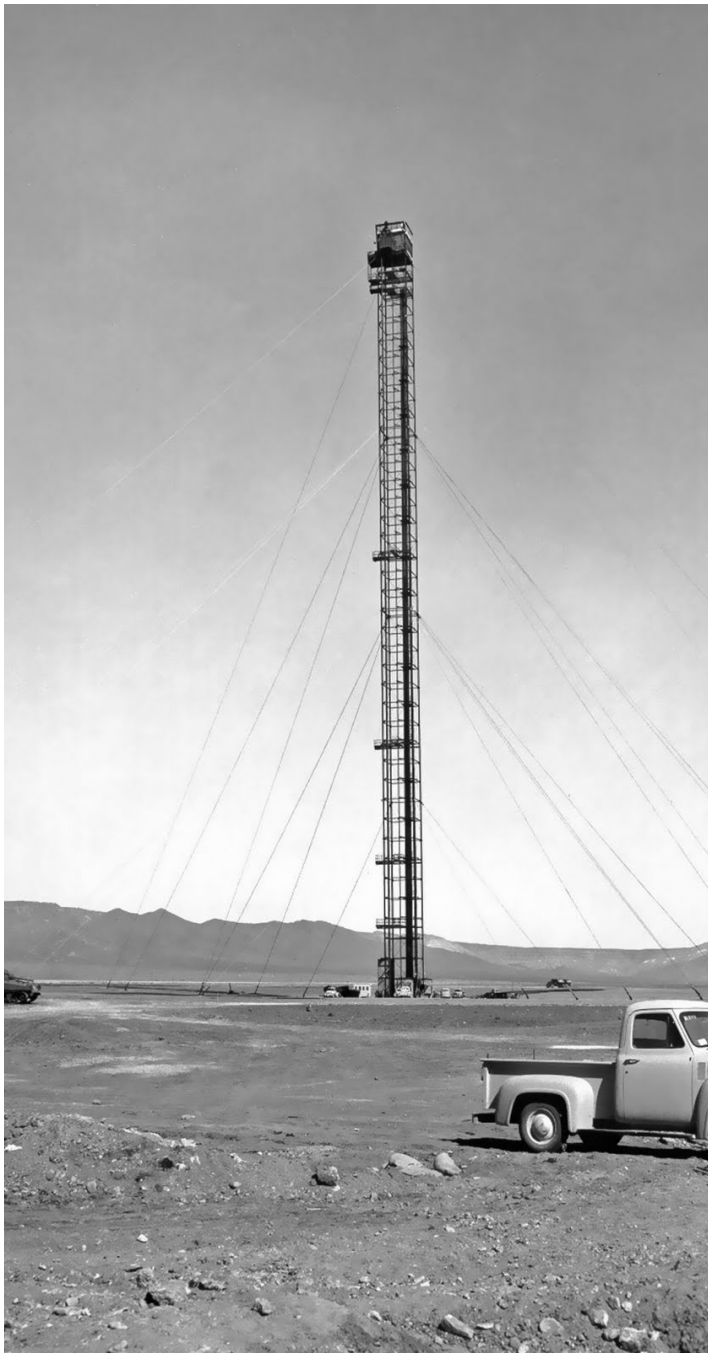
Historically Relevant Sites

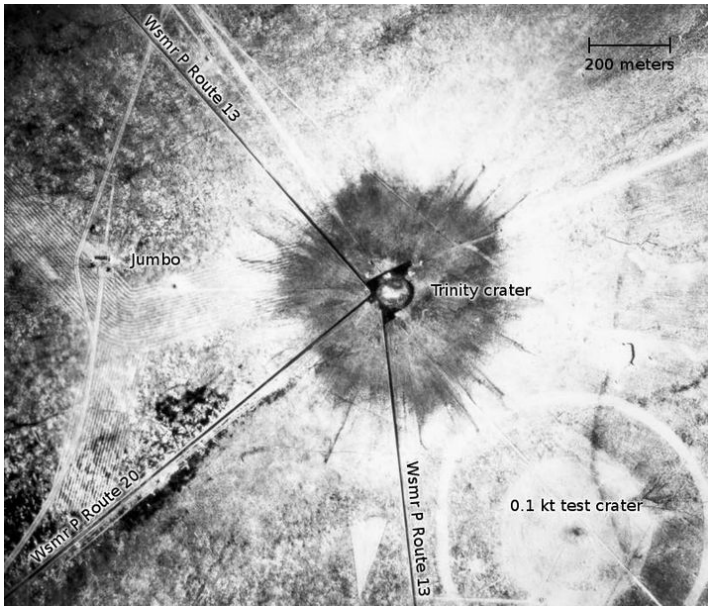
Filippo Testa


Project 596 - first Chinese nuclear test
Last Atmospheric test in the world
First use of fission
Largest Chinese test (4000 kilotons)
10 km

Tower Test

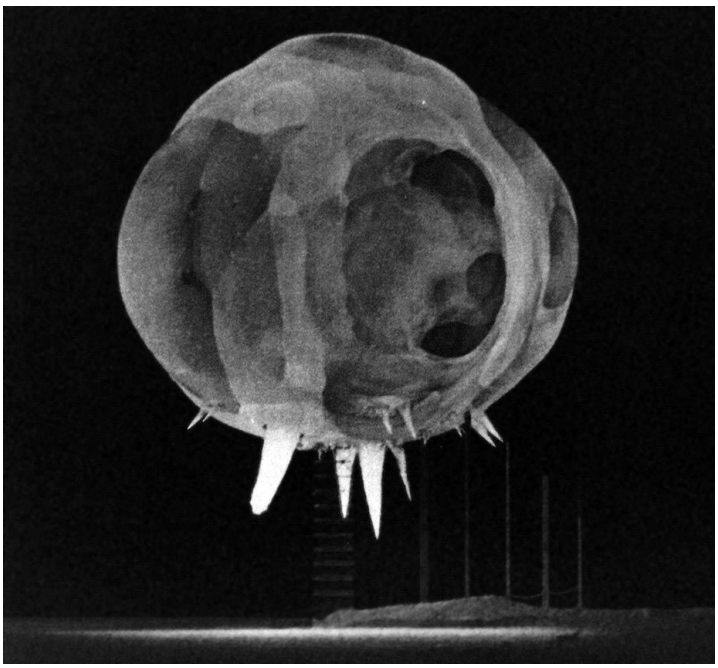
Filippo Testa

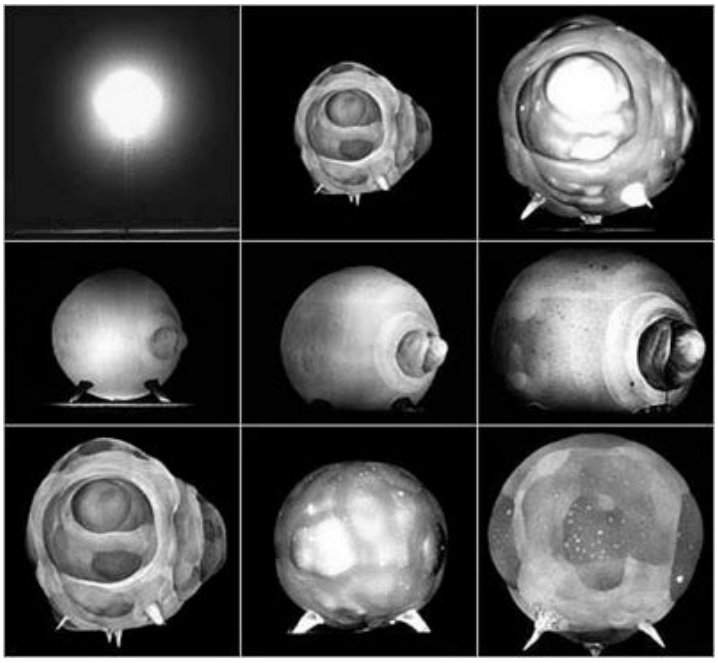


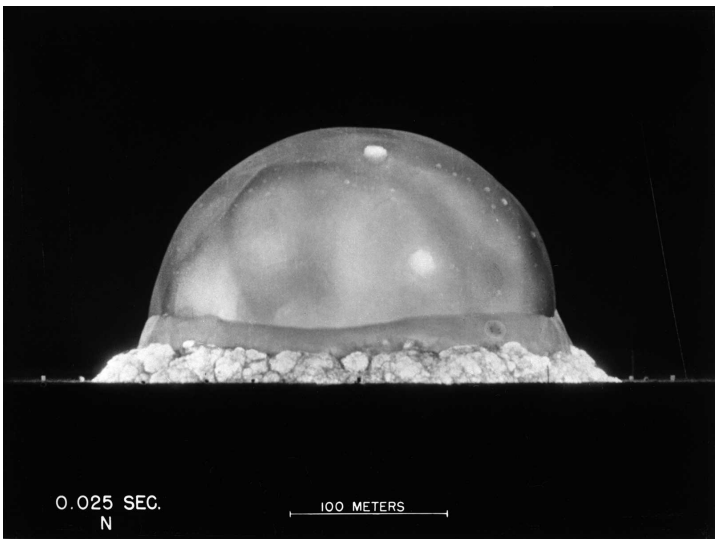

Wsmr P Route 13
200 meters
Jumbo
Trinity crater
Wsmr P Route 20
Wsmr P Route 13
0.1 kt test crater

Fireball | Explosion Study

Filippo Testa






0.025 SEC.
N
100 METERS

Cleanup of Large Areas Contaminated as a Result of a Nuclear Accident

International Atomic Energy Agency 1989

General Information on Cleanu

The experience at Chernobyl shows that the main long term radiological consequence to the population will probably be external exposure from radioactive fallout deposited on the ground.

To achieve a good decontamination factor (DF), a decontamination process must be selected on the basis of site specific considerations taking into account a wide variety of parameters such as:

- Type of material: metal, asphalt, concrete, soil, wood, etc.
- Type of surface: rough, porous, coated (paint, plastic, etc.)
- Composition of contaminant: activation or fission products, actinides, etc.
- Chemical and physical form of contaminant: solubility, aerosol, flocculent particles, complex compound with other materials, etc.
- The decontamination factor required
- The proven efficiency of the process
- The method of deposition

The selection of the proper technique will also make reclamation of the land following cleanup easier.

The rankings in Table VIII considered the environmental insult generated during the cleanup, the physical possibility of restoring the area to its original productive state, side effects caused by the equipment needed to perform the cleanup, the impact upon the environment adjacent to the cleaned up area, and the social acceptance of the cleanup work.
The selection of the most suitable methods of cleaning up large areas of contaminated land and restoring it to productive use is complicated by:

- the topography of the area to be cleaned up
- the large number of possible natural ecosystems and land uses
- the large number of vegetation types
- the large variation in the characteristics of soil classes
- the complex behaviour of radionuclides with different soils
- the varied response of the contamination to different weather conditions
- the ecological impact that different cleanup techniques have on different natural ecosystems and land restoration.

The final selection of the methods to be used to clean up an area must consider accident specific and site specific factors such as the type of contamination, how it was deposited, soil types, value of the land, alternative land use, population distribu- tion, size of the affected area and the equipment available.

Physical and Chemical Methods

The cleanup of land can be carried out by selectively separating the radionu- clides from the soil matrix, by deep ploughing to remove the contamination from the surface and the root zone or by removing the vegetation and/or top layer of soil con- taining the contaminants.

TABLE VIII. SUMMARY OF CONCLUSIONS ABOUT THE EFFECTS OF VARIOUS CLEANUP MEASURES ON THE SOIL, VEGETATION AND ANIMALS IN VARIOUS LAND USE CLASSES AND LAND TYPES [20]

	Land use classes		*Land types*						
	Suburban	Agriculture	Coastal/ intertidal marshes	Tundra	Mountain, subalpine	Coniferous forest	Deciduous forest	Prairie	Desert
Natural rehabilitation	4	4	4	3	4	4	4	3	4
Chemical stabilization	4	3	3	5	2	2	2	5	2
Clear cutting vegetation	4	3	3	5	2	2	2	5	3
Stumping and grubbing	4	3	3	5	3	3	3	5	4
Scraping and grading (<5 cm)	3	1	3	1	2	2	2	1	4
Shallow ploughing (<10 cm)	4	1	5	5	4	4	3	1	4
Deep ploughing (10–20 cm)	4	1	5	4	4	4	3	1	4
Soil cover (<25 cm)	2	1	2	2	3	3	3	2	4
Soil cover (25–100 cm)	4	1	3	4	4	4	4	3	4
Remove plough layer (10 cm)[a]	2	1	3	1	2	1	1	1	4
Remove shallow root zone (<40 cm)	4	1	3	2	3	2	2	1	4
Remove scraping and grading, mechanically stabilize	1	1	2	1	1	1	1	1	4
Remove plough layer (10 cm), mechanically stabilize	1	2	2	2	3	2	2	1	4
Remove shallow root zone (<40 cm), mechanically stabilize	4	2	3	2	3	3	3	2	4
Remove scraping and grading, chemically stabilize	2	2	4	5	3	3	2	1	4
Remove plough layer (10 cm), chemically stabilize	2	2	4	5	3	3	2	2	4
Remove shallow root zone (<40 cm), chemically stabilize	4	3	4	5	4	4	4	3	4
Barriers to exclude people	3	2	1	1	1	1	1	3	1
Barriers to exclude large and small animals	3	3	3	3	3	3	3	3	1
Mechanical stabilization by hard surface	5	4	b	b	b	4	4	3	4
Application of sewage sludge	a	1	b	b	b	0	0	b	b
High pressure washing (<3 cm)	a	a	b	b	3	b	b	b	b
Flooding (3 to 30 cm)	a	a	b	b	5	b	b	b	b
Soil amendments added	a	4	b	b	b	b	b	b	b

[a] Increases the severity of scraping and grading.
[b] Outside the scope of this work.

Global Agenda

Nuclear Waste Repository

Filippo Testa

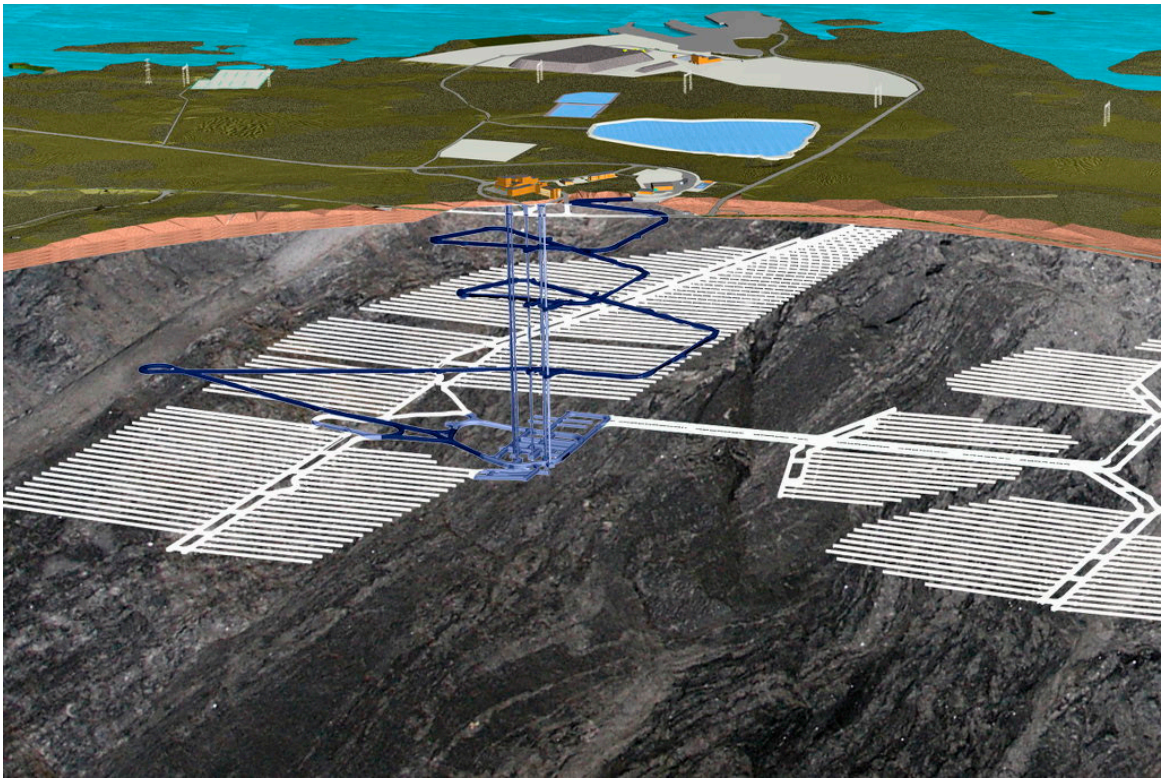
Precedent: Onkalo Nuclear Waste Repository Finland

The Onkalo spent nuclear fuel repository is a planned deep geological repository for the final disposal of spent nuclear fuel. It is near the Olkiluoto Nuclear Power Plant in the municipality of Eurajoki, on the west coast of Finland. It is being constructed by Posiva, and is based on the KBS-3 method of nuclear waste burial developed in Sweden by Svensk Kärnbränslehantering AB (SKB). The facility is expected to be operational in 2023.

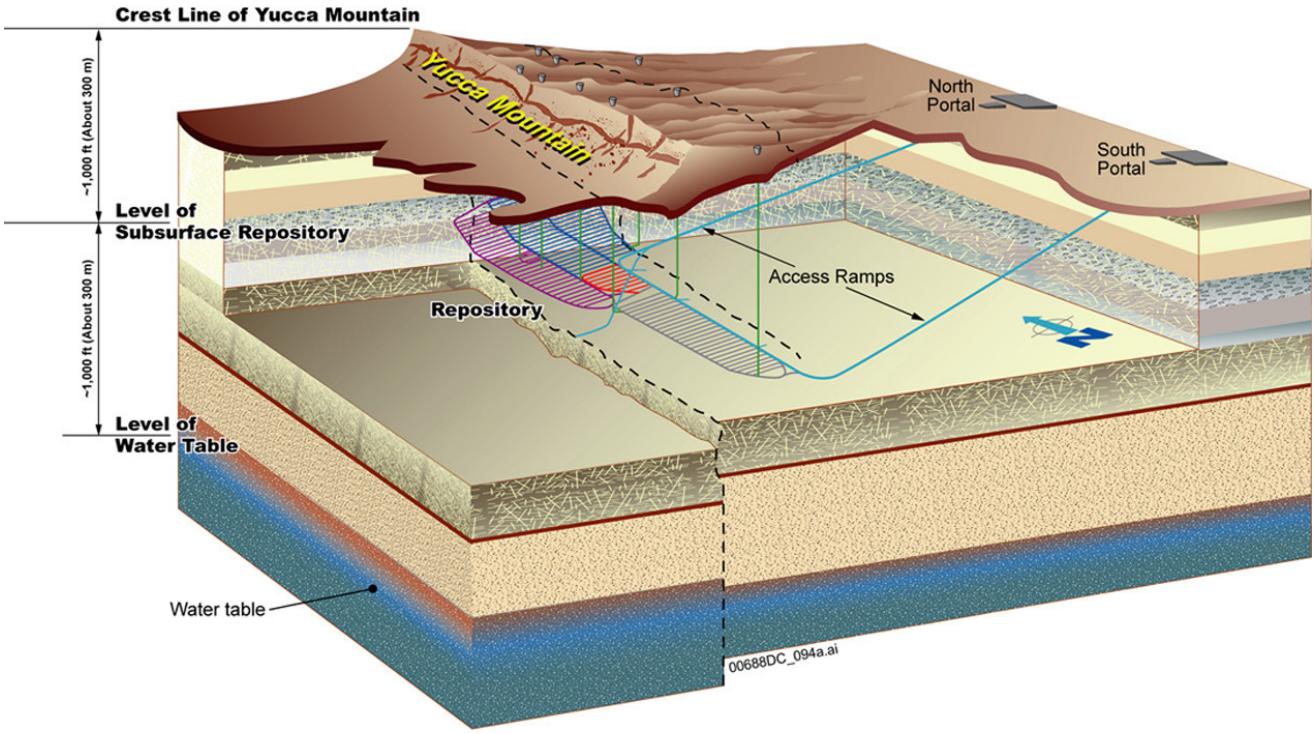
After the Finnish Nuclear Energy Act was amended in 1994 to specify that all nuclear waste produced in Finland must be disposed of in Finland, Olkiluoto was selected in 2000 as the site for a (very) long-term underground storage facility for Finland's spent nuclear fuel. The facility, named "Onkalo" (meaning "small cave" or "cavity") is being built in the granite bedrock at the Olkiluoto site, about five kilometers from the power plants. The municipality of Eurajoki issued a building permit for the facility in August 2003 and excavation began in 2004.

The site was selected after a long process, which started in 1983 with a screening of the whole Finnish territory. From 1993 until 2000, four prospective sites were examined: Romuvaara in Kuhmo, Kivetty in Äänekoski, Olkiluoto in Eurajoki and Hästholmen in Loviisa. Besides geological and environmental considerations, the opinions of local residents were also taken into account. Eurajoki and Loviisa were singled out for being the locations with the highest local support. The former also had more favorable geographic conditions, thus in 1999 Posiva proposed it to the Finnish government as the selected location. The municipality of Eurajoki confirmed its approval of the site, and the national government ratified the decision in May 2001.

Posiva started construction of the site in 2004. The Finnish government issued the company a licence for constructing the final disposal facility on 12 November 2015. As of June 2019 Posiva expects operations to begin in 2023



Precedent: Yucca Mountains Waste Repository USA


Crest Line of Yucca Mountain
~1,000 ft (About 300 m)
Level of
Subsurface Repository
~1,000 ft (About 300 m)
Level of
Water Table
Yucca Mountain
North
Portal
South
Portal
Access Ramps
Repository
Water table
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Current Chinese Agenda

Filippo Testa

South China Morning Post

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China builds bunker to test whether nuclear waste can be dumped underground

- Lab more than 500 metres underground in the Gobi Desert will be the world's largest of its kind
- If research there is successful, a long-term underground dump for high-level radioactive waste could be built, helping to address a global problem

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China's tech billionaires

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- China's record fine sets Alibaba as an example for tech giants
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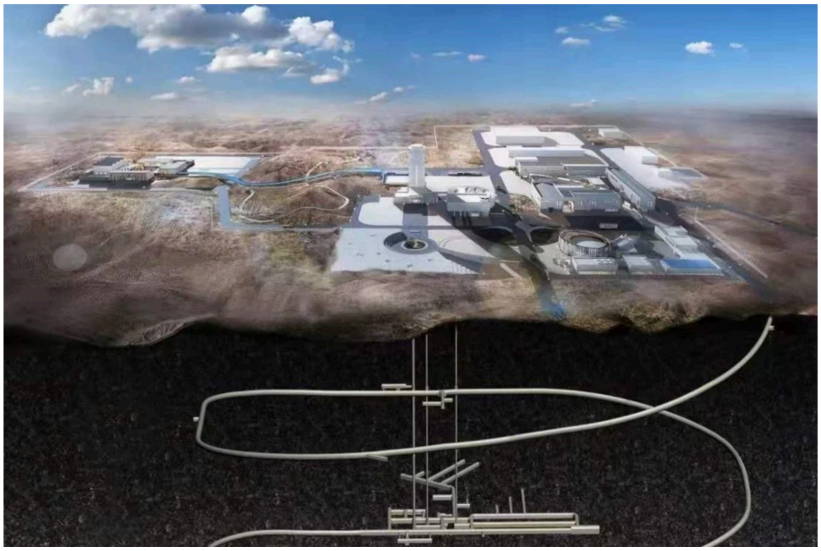
- Baidu flops in Hong Kong stock debut as market risks temper IPO craze



The new Chinese lab, to be built underground in Gansu, will be used to research storage of high-level radioactive waste. Photo: Handout

Nuclear Waste Types

Radioactive wastes have to be managed safely and isolated from our living environment for as long as they remain harmful. Carefully implemented procedures and proper practices ensure that no adverse effects on human health will result.

For the purpose of disposal, the Nuclear Energy Ordinance (Article 51) divides radioactive waste into the following categories:

High-level waste (HLW)

- Spent fuel assemblies (SF) not destined for reprocessing
- Vitrified fission product solutions from reprocessing of spent fuel

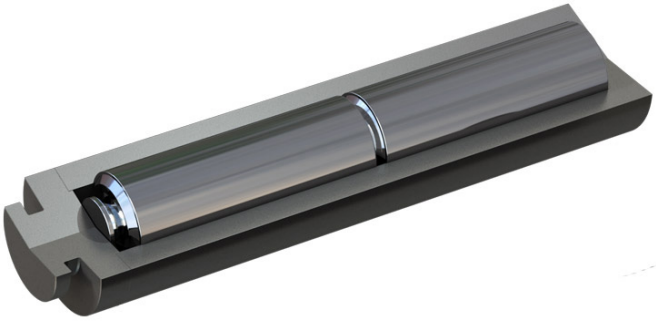
Fission products and other activation products are separated out and melted together with additives to form a glass. The solidified glass blocks have to be disposed of as high-level waste.
Spent fuel not destined for reprocessing is also treated as high-level waste. It is held in interim storage for several decades and then emplaced in a deep geological repository.

Alpha-toxic waste (ATW), with a content of alpha-emitters exceeding a value of 20,000 Becquerels per gram of conditioned waste

Low- and intermediate-level waste (L/ILW)

- All other radioactive waste The nuclear power plants are the largest producers of radioactive waste.

The nuclear power plants are the largest producers of radioactive waste.
The fission and activation products from spent nuclear fuel represent high-level waste. Operational waste and decommissioning waste arising from the dismantling of the nuclear power plants require to be disposed of as low- and intermediate-level waste.



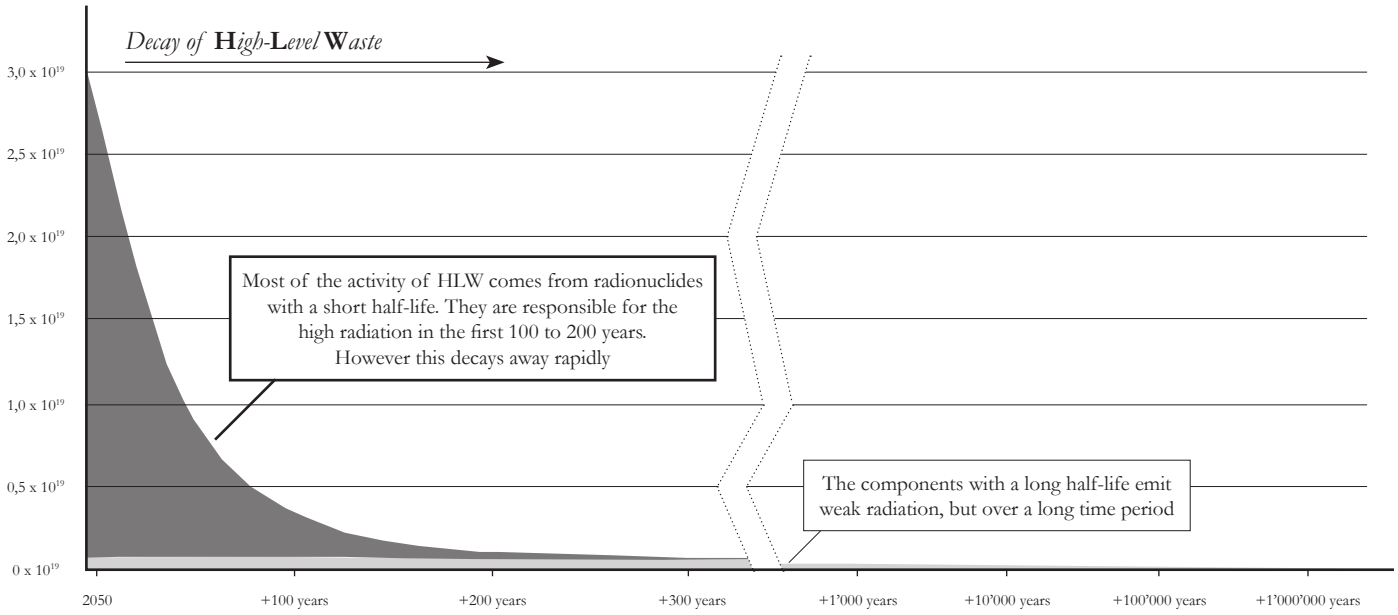
Radiation

Radioactive waste contains radioactive forms of a range of different elements.
Its composition is known, which allows the decrease in radioactivity with time to be calculated for different waste types. It is true for all waste types that their toxicity is decreased by radioactive decay until it reaches natural levels. However, the time required for this varies widely for the different waste types.

After around 30,000 years, low- and intermediate-level waste has a radiotoxicity equivalent to that of granite. After around 200,000 years, the radioactivity of spent uranium fuel reaches that of the naturally occurring uranium that was originally mined to produce it.

Radioactive waste has to be isolated from our living environment during these long time periods. *It is recognised worldwide that disposal in geologically stable rock formations can ensure safety over the long time spans involved.* Radiation from the waste is shielded by the waste containers, the tunnel backfill, the repository installations and the surrounding rock. The safety barriers also prevent radioactive substances from being dissolved in water and transported to the earth's surface, where they could enter the food-chains.

A geological repository has to ensure the long-term protection of man and the environment. The safety authorities have specified objectives that quantify the required level of protection. At no time shall the release of radionuclides from a sealed repository give rise to individual doses that exceed 0.1 millisieverts per year.


Decay of **H***igh*-**L***evel* **W***aste*
3,0 x 10^19
2,5 x 10^19
2,0 x 10^19
1,5 x 10^19
1,0 x 10^19
0,5 x 10^19
0 x 10^19
Most of the activity of HLW comes from radionuclides with a short half-life. They are responsible for the high radiation in the first 100 to 200 years. However this decays away rapidly
The components with a long half-life emit weak radiation, but over a long time period
2050
+100 years
+200 years
+300 years
+1'000 years
+10'000 years
+100'000 years
+1'000'000 years

Waste Disposal

Radioactive waste must be disposed of in a way that ensures the permanent protection of humans and the environment. To achieve this goal, it must be kept separate from our habitat. Numerous geological investigations have shown that the underground in different areas of the world has remained undisturbed over very long periods of time.

Based on the current level of knowledge, deep geological disposal is the only method that meets the stringent requirements for long-term safety. Deep geological dispos is recognised by experts worldwide.

Aside from deep geological disposal, other waste management solutions have been examined. For example:

- Diluting the radioactive waste and dispersion in the environment
- Disposal in undisturbed marine sediments
- Disposal in Antarctic ice-sheets
- Disposal in outer space

These concepts are no longer pursued. Disposing of waste in the sea, for example, is highly disputed and legally prohibited today. Using rockets to aid in the disposal presents too high a risk in case of explosions on take-off. Rock formations, however, can remain stable and retain their properties over many millions of years, allowing the safe containment of radioactive waste over very long time periods. Deep below the surface and unaffected by occurrences at the earth's surface, time essentially comes to a standstill.

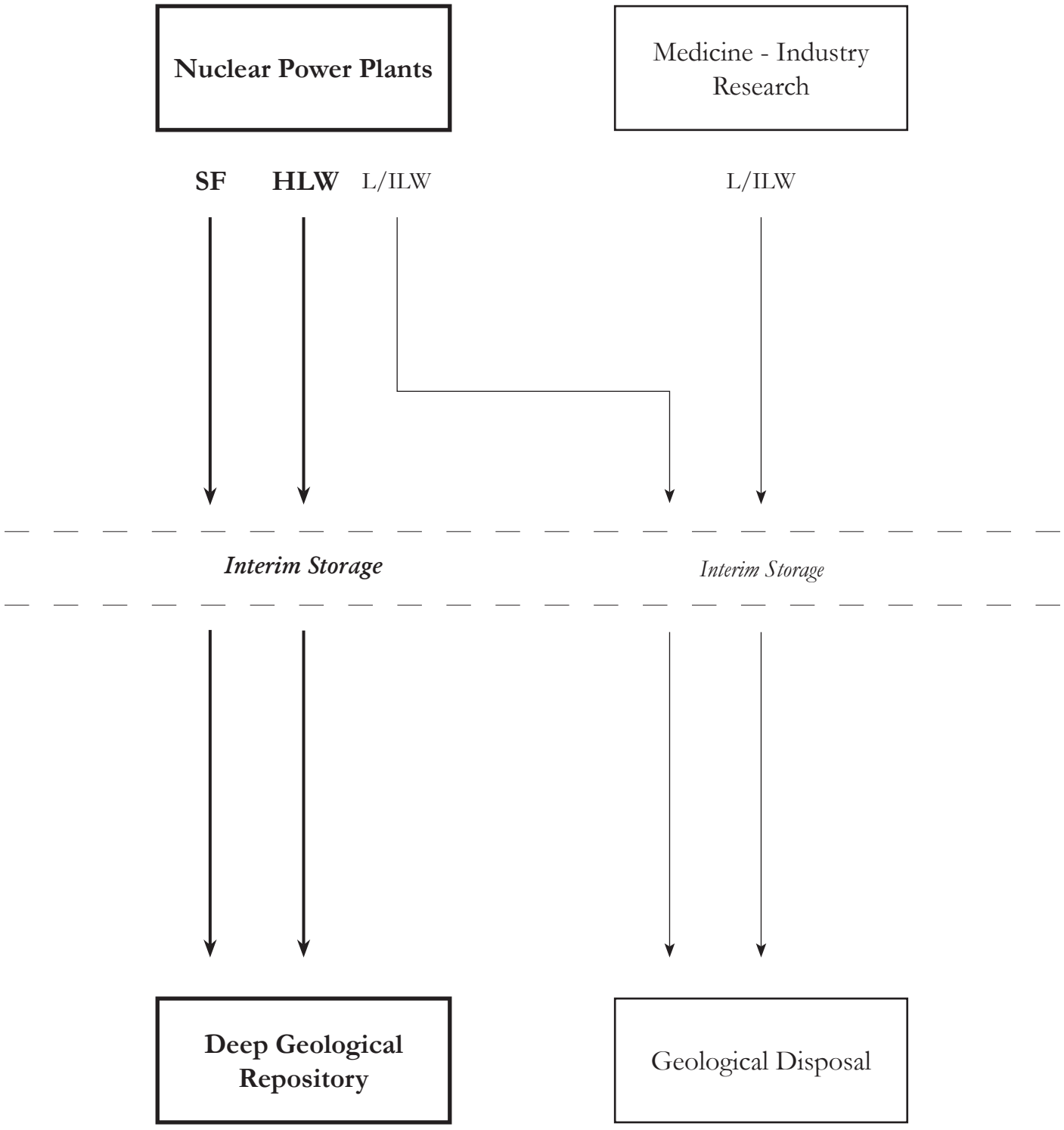
It is recognised worldwide that, for high-level and long-lived intermediate-level waste, disposal in stable geological formations is the only way to ensure safety over the necessary long time spans.
This principle is anchored in the Nuclear Energy Act of 2003 and also applies in Switzerland to low- and intermediate-level waste.

In facilities at the surface, the waste can be directly controlled and monitored and is easily retrievable. However, such facilities require ongoing supervision and maintenance. An absolute prerequisite for this is stable societal conditions over the necessary long timescales. In contrast to geological conditions and the evolution of the engineered safety barriers, social and climatic changes cannot be reliably predicted. For this reason, geological repositories are preferable.
Throughout society, it is generally agreed that toxic wastes have to be handled responsibly.
The generations producing the waste have to take responsibility for its safe management and the concerns of present and future generations have to be taken into consideration. The waste management strategy should not be based on the assumption that social structures will remain stable into the distant future, nor should it assume further technological advances in the field.

In 1995, the International Atomic Energy Agency (IAEA) issued nine safety principles for handling radioactive waste; these are based on fundamental ethical considerations. The following two principles in particular are linked directly with the ethical problem.

Principle 4
Protection of future generations: Radioactive waste shall be managed in such a way that predicted impacts on the health of future generations will not be greater than relevant levels of impact that are acceptable today.

Principle 5
Burdens on future generations: Radioactive waste shall be managed in such a way that will not impose undue burdens on future generations


Nuclear Power Plants
Medicine - Industry Research
SF
HLW
L/ILW
L/ILW
Interim Storage
Interim Storage
Deep Geological Repository
Geological Disposal

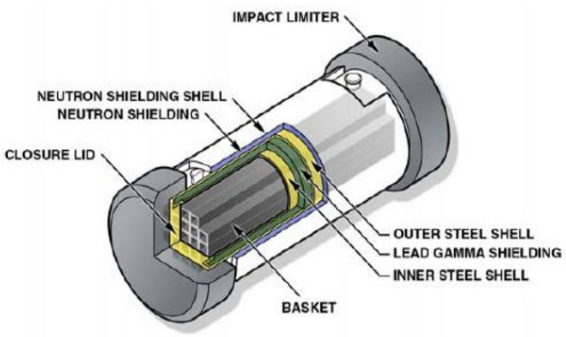
Radiactive Waste Transport

Transporting nuclear waste requires a sturdy container that can shield from radioactivity. A specially designed container called a cask is used. There are different cask types for different purposes, but they all have similar overall design to maximize the containment of radioactivity.

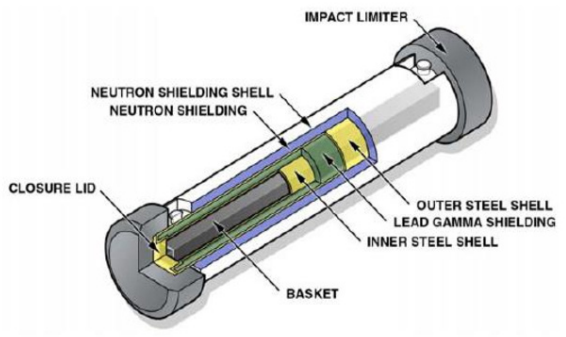
A cask is a strong, heavily-shielded, double-walled container. The outer structure is made of several inches of high-strength steel. The inner structure is usually made of steel as well. Casks meant to transport used nuclear fuel assemblies have a rack of square openings in this inner structure to provide support for those assemblies. If the cask is being used for transporting used nuclear fuel assemblies, the rack may also contain neutron-absorbing materials to safeguard against the unlikely event of a nuclear chain reaction.

transportFor transporting used nuclear fuel assemblies, the inner canister is dried and filled with an inert gas (usually helium) to prevent long-term corrosion of the fuel assemblies. The casks also usually feature several inches of lead or depleted uranium (which is not radioactive) between the inner and outer structures to provide gamma ray shielding. The inner canister is then sealed, preventing any release of radioactive material. Large honeycomb structures made of wood, foam, or aluminum are placed on the ends of the casks to absorb the force the cask would experience in the event of a drop.

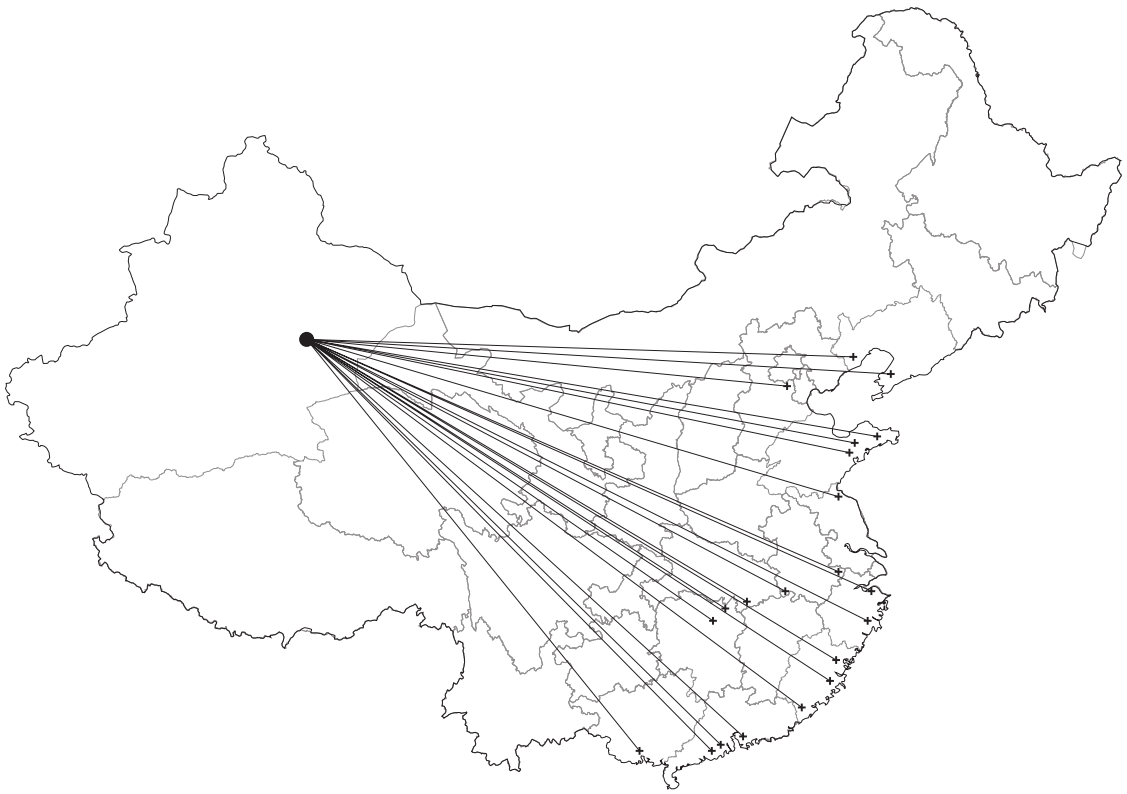
Materials such as used nuclear reactor fuel assemblies, radioactive resins (such as those used to filter radioactive material from water), contaminated clothing or tools, and isotopes used in nuclear medicine are some examples of nuclear waste that may be transported in a cask.



Generic Rail Cask for Spent Fuel



Generic Truck Cask for Spent Fuel



HLW Repository

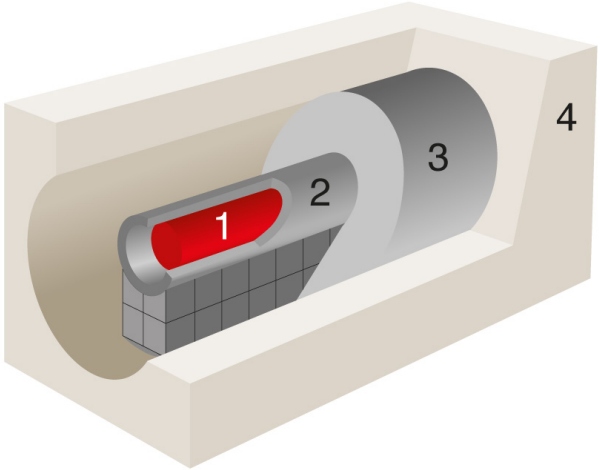
A ramp or a vertical shaft provide access to the disposal zone for high-level waste at a maximum depth of around 900 metres. The pilot facility can also be used to monitor the behaviour of the safety barriers after the emplacement drifts in the main repository have been closed.

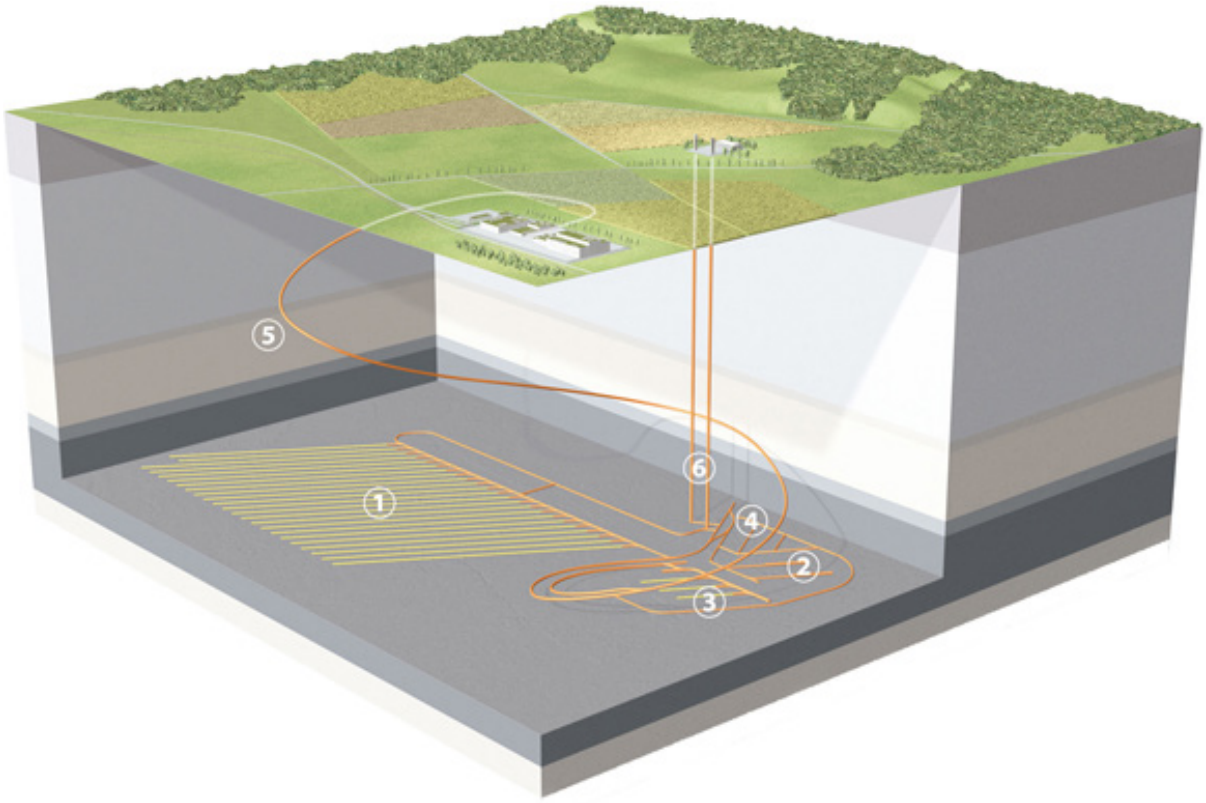
The surface infrastructure forms part of a deep geological repository. A deep geological repository for radioactive waste also consists of facilities built at or close to the earth's surface. This "surface infrastructure" is required for the construction and operation of the repository.

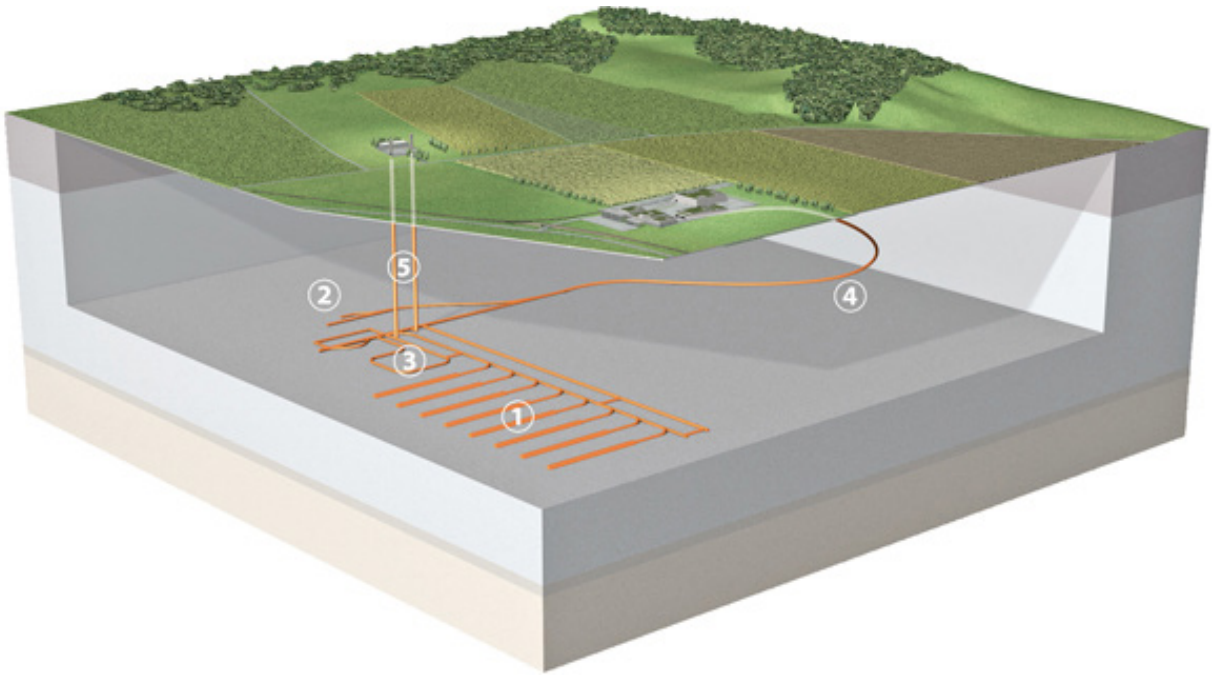
The high-level waste repository comprises drifts with a diameter of 2.5 metres for the emplacement of canisters with spent fuel assemblies and vitrified high-level waste.

High-level waste will be transported preferably by rail or trucks from the power / research plant to the repository. After an entry control, the transport casks with the high-level waste are brought to the encapsulation plant, where they are checked and removed from the rail waggon. In the next step, the waste is removed from the transport casks and loaded into thick-walled disposal canisters that are then welded closed. The process is remotely controlled and carried out under very strict safety precautions.

The disposal canisters are then loaded individually onto the tunnel railway. The locomotive drives through the access tunnel to the underground emplacement drifts. In the emplacement drift, the canister is loaded onto a plinth of clay blocks on an emplacement trolley and brought to the emplacement position. The canisters are emplaced individually one after another in the drift with spaces in between. The drift is continuously backfilled with compacted bentonite granulate. Once the emplacement phase is complete, the open accesses to the emplacement drifts are backfilled and sealed. The disposal canisters can be retrieved at any time.




5
6
1
4
2
3


5
2
4
3
1

Natural Barriers

These analyses have to be based on an adequate understanding of system behaviour, which can be obtained in part from studies of so-called natural analogues - processes and situations similar to those occurring in a geological repository and its surroundings can also be found in nature. The information obtained from these studies improves our understanding of the long-term behaviour of radioactive waste repositories. Compared to short-term laboratory experiments, processes that have extended over thousands of years can be studied in nature.

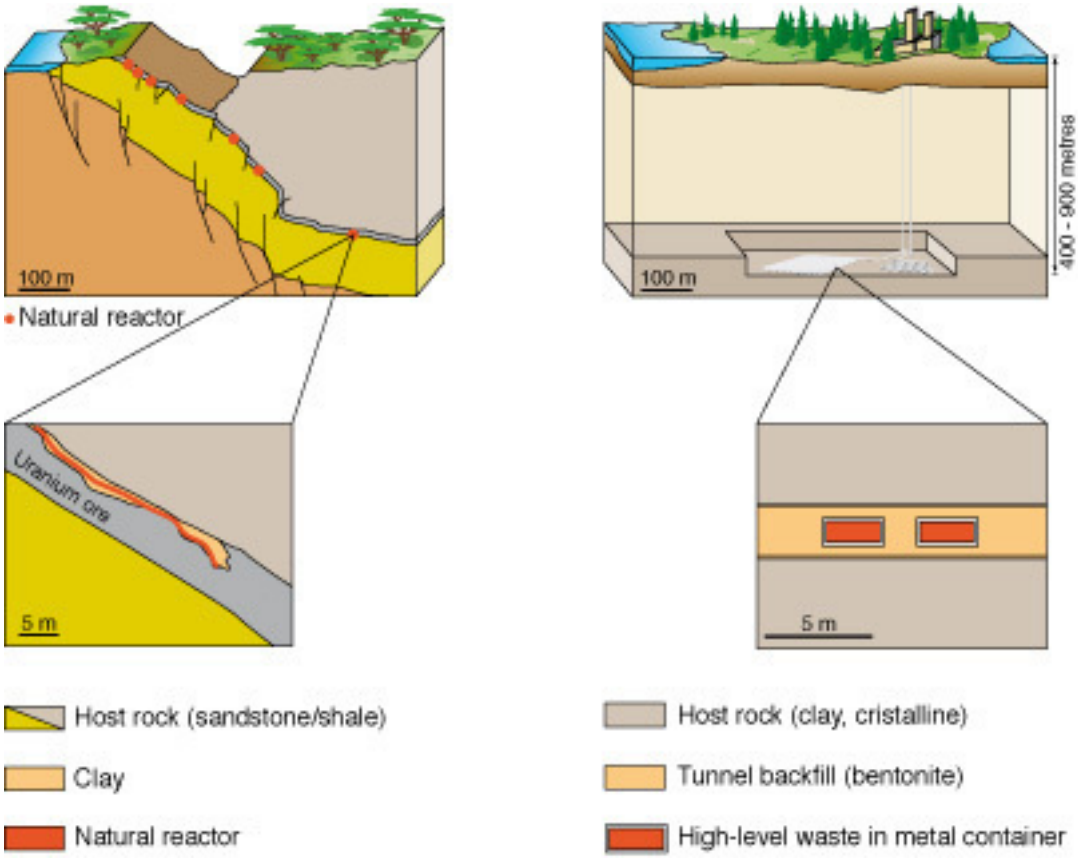
During the span of a human lifetime, it is not possible to directly witness many geological processes as they occur very slowly. This lack of possibilities for direct observation can be made up by drawing conclusions from interpretations of natural phenomena.

Engeneered Barriers:

- *Glass* - Because of its favourable properties, glass forms the innermost engineered barrier in a geological repository for high-level waste. Radioactive elements are immobilised in a glass matrix which is very difficult to corrode or dissolve. The radioactive substances are thus safely contained for long time periods.

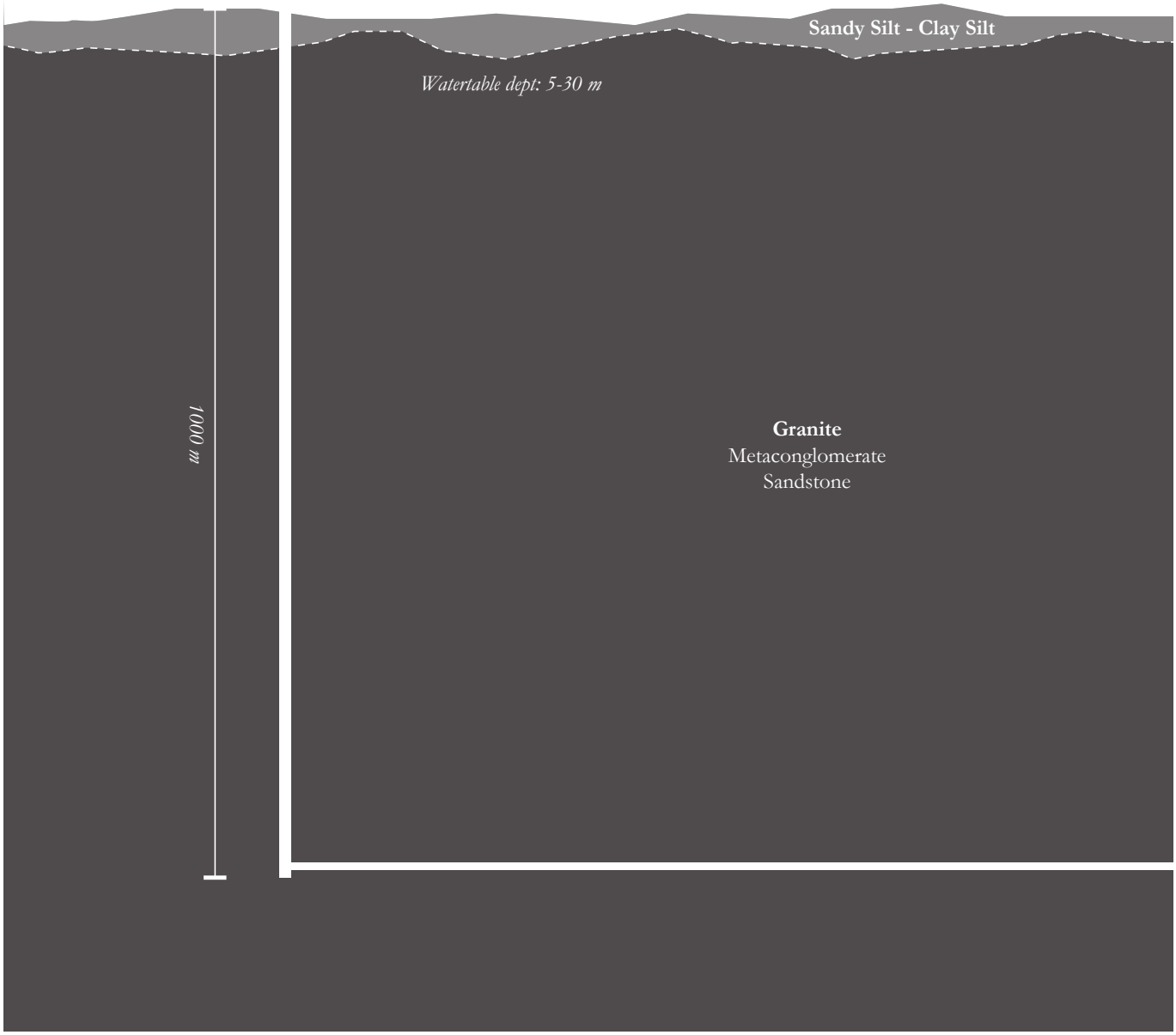
- *Metal* - Steel is an iron alloy with a low content of carbon, which slows down the rusting process. On contact with oxygen-rich water, iron rusts on the surface, but the resulting rust layer provides protection for the underlying metal and delays the progress of the rusting process.

- *Clay* - As a backfill material in the waste emplacement tunnels, the role of clay material is to keep infiltrating water away from the disposal containers and retard the transport of any released radionuclides. Bentonite clay fulfils both of these requirements. It can take up large amounts of water, which causes it to swell. It also has the ability to bind radionuclides on the long term and to retard their migration. For these reasons, the voids surrounding the waste containers are filled with swelling bentonite.


100 m
Natural reactor
Uranium ore
5 m
100 m
400 - 900 metres
5 m
Host rock (sandstone/shale)
Clay
Natural reactor
Host rock (clay, cristalline)
Tunnel backfill (bentonite)
High-level waste in metal container

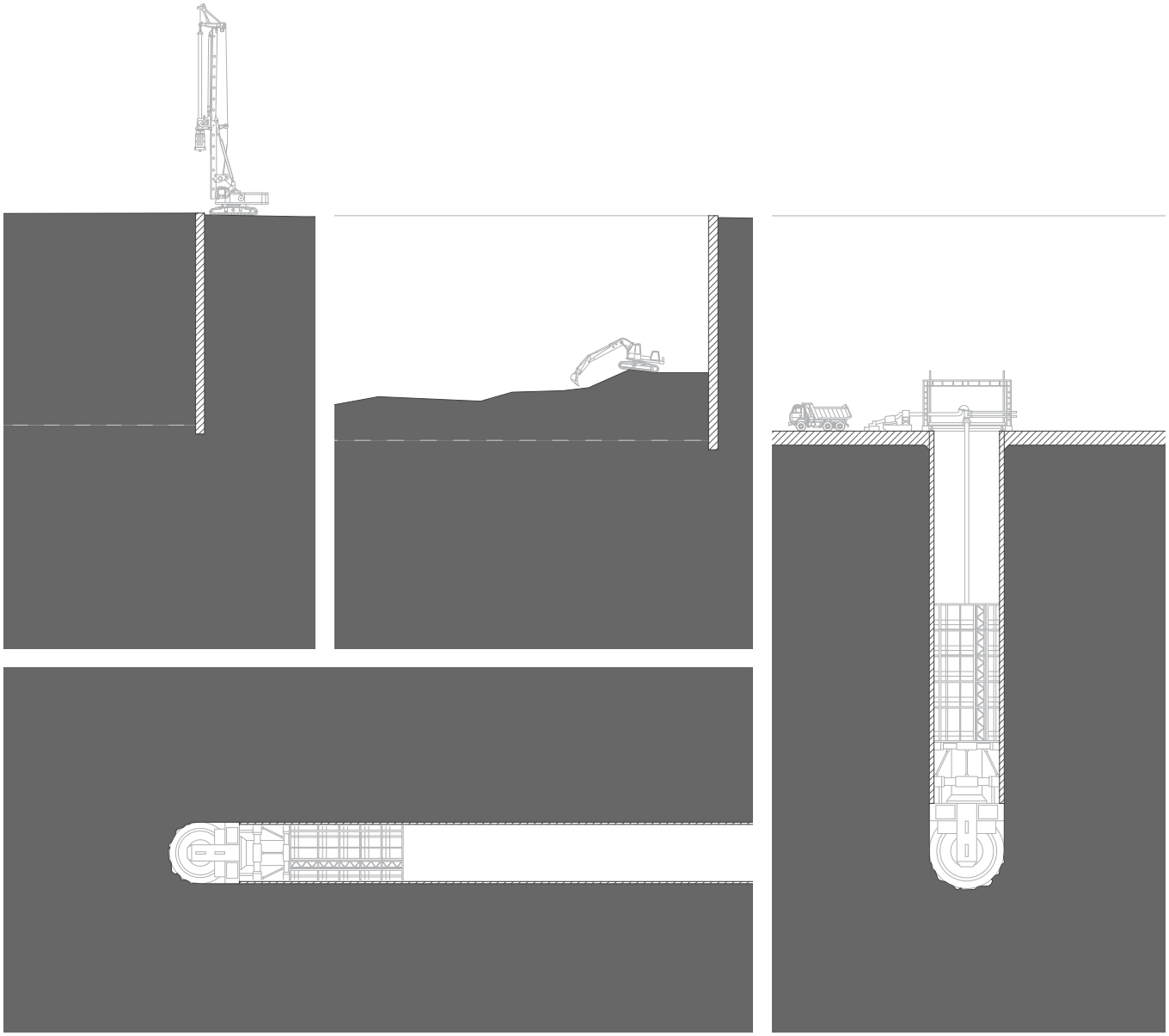
Repository Dept and Geological Formation of Lop Nor

Filippo Testa


Sandy Silt - Clay Silt
Watertable dept: 5-30 m
1000 m
Granite
Metaconglomerate
Sandstone

Construction Technicalities

Filippo Testa



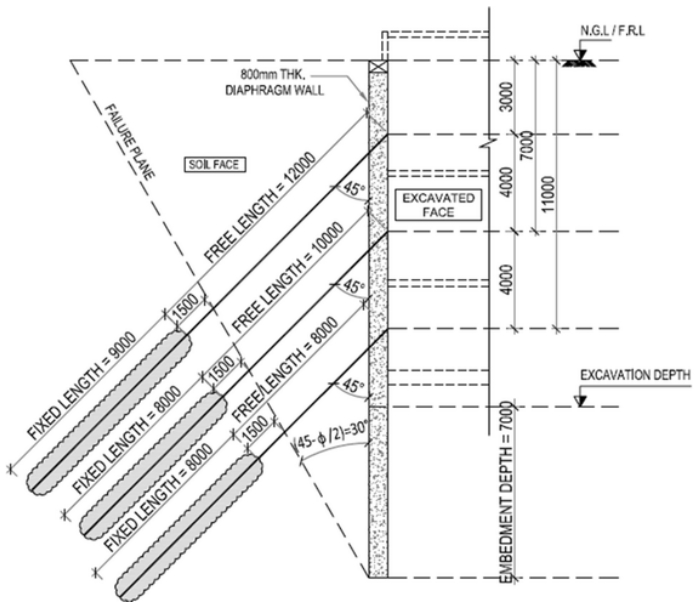
Underground Construction Methods

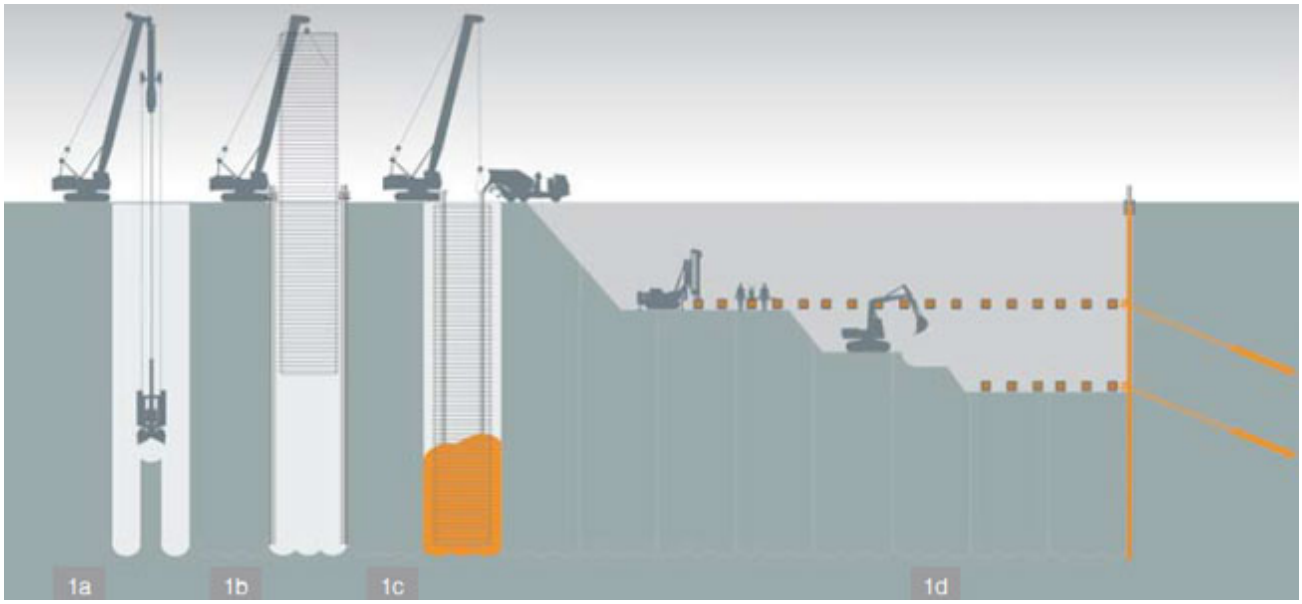
The retaining walls would be constructed from the top down as the excavation progresses. Each new retaining wall would be stepped towards the center of the excavation to avoid undermining the retaining wall above. The concrete diaphragm walls could be in the order of 25m deep and 1-2m thick depending on the forces and ground conditions. The rock anchors would be arranged at close spacings in rows at different levels throughout the height of the excavation. The anchors would be permanently fixed into the rock with primary and secondary grouting which is pumped under high pressure into the voids and fissures in the rock to ensure the required design load capacity is achieved. Ground anchor lengths could be in the order 150mm diameter and 40-50m long.

A diaphragm wall (D-wall) is a reinforced concrete structure constructed in situ panel by panel. In the basement market D-walls are often used on congested sites, close to existing structures where the excavation depth and ground conditions would prove problematic for piled walls.

The D-wall construction sequence can be summarised as following:

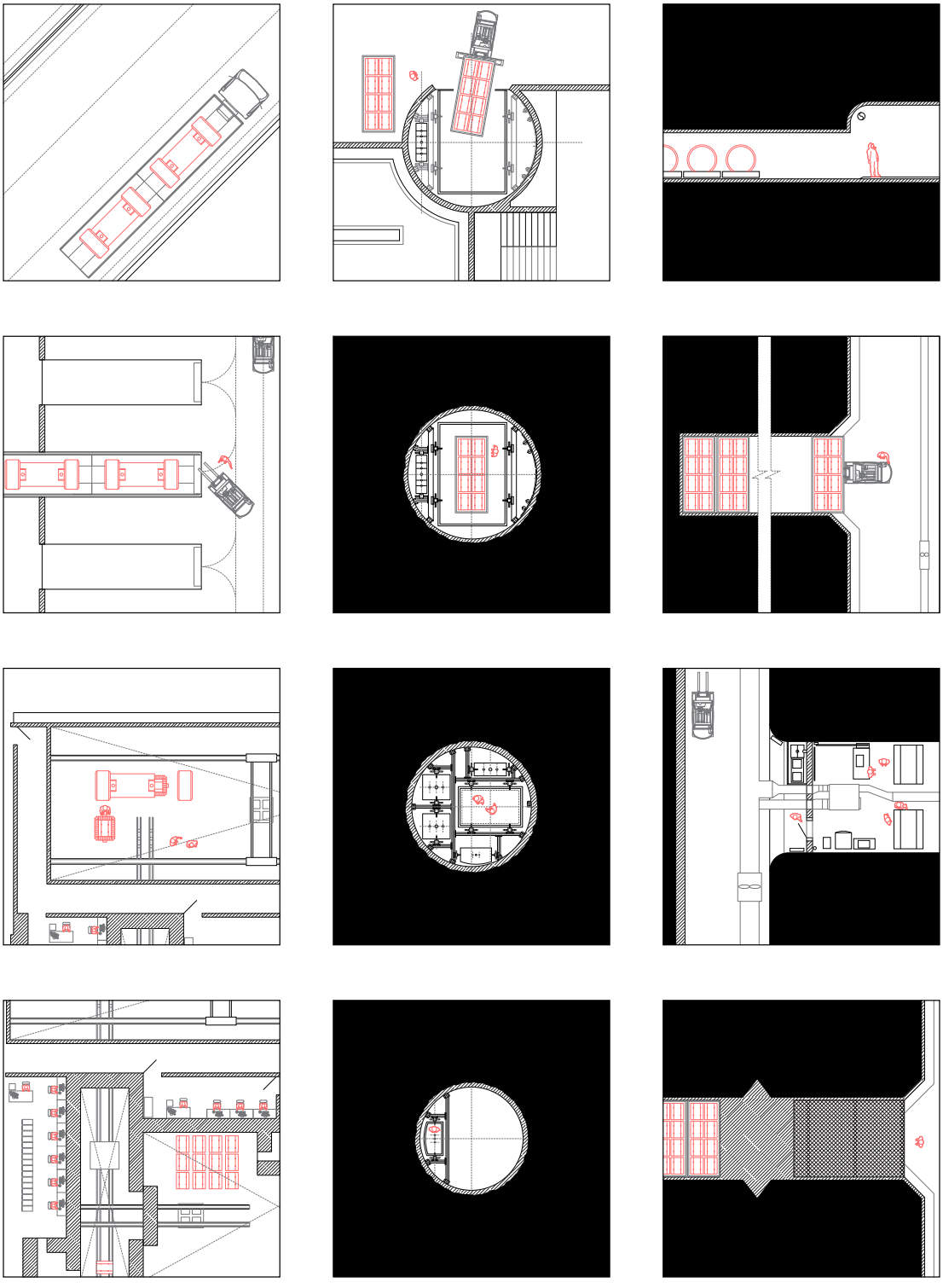
- Construct guide wall at working platform level – typically two parallel concrete beams to control panel alignment.
- Excavate rectangular panels with rope-suspended mechanical or hydraulically-operated grabs. Where penetration is required through strong rock hydromills, hydraulically operated reverse circulation trench cutters may be adopted.
- Support trench excavation with bentonite or polymer slurry to enable excavation below groundwater table in all ground conditions.
- Install temporary stop ends to form the joints between adjacent panels normally with a water stop included at the joint.
- Place the panel reinforcement cages and tremie the concrete.




1a
1b
1c
1d

Waste Process

Filippo Testa



Shaft Headframe Study

Filippo Testa