Tecno-cerâmica

Techno-Ceramics

Noemi Iglesias Barrios
PhD candidate at the Faculty of Fine Arts in Lisbon (FBAUL), Member of CIEBA Research Centre for Fine Arts and VICARTE Research Unit for Glass and Ceramics. Fellowship of the FCT – Foundation for Science and Technology in Portugal.

Resumo
Um objeto tecnocerâmico é um fóssil índice da sociedade moderna concebido para explorar formas possíveis de geo-subjetividades, aplicando ações respeitosas aos recursos naturais na criação de objetos cerâmicos. A metodologia enfoca os procedimentos de reciclagem e reutilização de minerais pré-extraídos encontrados em nossos dispositivos eletrônicos obsoletos para obter as informações necessárias, matéria-prima e habilidades para desenvolver insights sobre as perspectivas de artefatos cerâmicos sustentáveis.
Como testemunho lítico do nosso estilo de vida digital, a proposta tecnocerâmica pretende responder de forma concisa às questões ambientais derivadas do nosso tempo tecnológico atual.

Abstract
A techno-ceramic object is an index fossil of modern society conceived to explore possible forms of geo-subjectivities, applying respectful actions towards natural resources in the creation of ceramic objects. The methodology focuses on the recycling and re-use procedures of pre-extracted minerals found in our obsolete electronic devices to obtain the necessary information, raw material, and skills to develop insights into the prospects of sustainable ceramic artifacts.
As a lithic testimony of our digital lifestyle, the techno-ceramic proposal aims to respond concisely to the environmental questions derived from our current technological time.

Keywords
Techno-Ceramics, E-Waste, Cobalt, Urban Mining, Sustainability.

MINING THE LANDSCAPE: A delusive code of progress
Everything we manufacture has the potential to become a geological legacy, once interred through landfill or other burial processes. For this reason, it is important to adequately understand the historical and contemporary processes subjected to the forced removal of raw material from the earth's surface, depths and biosphere.

Mining activities have been closely linked to the development of human history since prehistoric times as they transform pure ore into commodities to construct and provide services to society, producing wealthy regions and countries.

However, the current depletion of natural resources required for us to live our networked life is consequently leading to the appropriation and expropriation of spaces, values, infrastructures and forms of life that are subjected to capitalist valuation and processes of dispossession.
As our rare earth minerals such as cobalt and other materials are needed to make our digital media machines work, the used, outdated and obsolete media technologies are returning to the earth as a residue of our digital culture. These mineralised remnants of electronic waste structures have planetary consequences as they are bound to shrink as a sediment and permanent component. They become a stratum, and thus the mineral signature that marks our current technological time.

Looking at the cycle of this technological waste, we notice that it is registering a material signal in the earth crust that is “stratigraphically sharp and globally widespread” (Zalasiewicz, Williams and Waters 2014, 40).

Discarded things reflect a society’s value system and we should consider digital debris, and its recycling methodology, as a crucial point of reference for any attempt to imagine alternative futures and more equitable and ecologically sustainable ways of inhabiting the planet. The Techno-Ceramics proposal departs from this context of environmental emergency to act and present ways of re-configuring the wasted electronic materials from our daily digital devices and showcasing how innovation through experimentation and artistic-driven practices can lead to solutions for a positive impact.

“The Cloud”, a stratigraphic taxonomy.

If we are to assess ‘The Cloud’ as a group of highly technical communication devices and advanced technologies operating with the data storage aspects, we can classify them as an immaterial materiality. The physical presence of these technologies rely upon material components, mined and semi-mined and can be found in the vast array of our daily electronic devices.

Electronic waste has a little grade of biodegradability in the compost environment. Despite the existence of conventional disposal resources for this type of detritus, the methodology usually presents a considerable number of disadvantages from an economic, technical, social and environmental point of view due to the high costs involved in the collection, storage, transport, reuse, classification, recycling and final disposal. Therefore, more efficient management options has to be considered for this type of waste.
The following chart provides a list of minerals involved in

Batteries	Li, Co, Al, C
Antennas	Al, stainless steel and brass, Cr, Ni
Data storage media	Fe, Cr
Lighting equipment	Hg,Pb, rare earth metals, Hg, thallium
Cables and wires	Cu, Sn-Pb, Pb, Cd, Ti, Fe, Cr and plastics
Sensors	Cr, Mg, Fe, Co, Ni
Connectors	Fe, Cu, Ni, Cr, Ag, Pd, Au
Sound generation	Ni, Mn, Zn, Co, Cr, Si, Mo, Ti, Al, C, Via, Sm, Sr, Se, Pr, Nd
Protecting details	Fe, Al, plastics, wood

the making process of an electronic device:
If we were to look closer at this list of minerals that form our digital reliefs and direct our inquiry from the position of the ceramicist, mineral and elementally speaking, the correlation, repetition and usage of material matter is closely linked: in geological terms, the composition of an electronic device is similar to the composition of a ceramic object.
Furthermore, there is one specific mineral that captures our attention due to its constant presence and relevance throughout the history of art: cobalt.

Innovation wears blue
Cobalt is one of those metals that define the modern world, as it is used in the production of lithium batteries for mobile phones, electronic devices and electric vehicles in order to improve its performance.

There is a continually increasing wealth of studies and research about the current impact of Cobalt in, on and to our digital time. These studies are usually introduced from a scientific, biological or even political perspective to promote sustainable sourcing and a responsible use of the mineral.
The article "On the multiple frontiers of extraction: excavating contemporary capitalism" published by the Department of Political and Social Sciences at the University of Bologna in 2017, written by Professor Sandro Mezzadra (University of Bologna) and Professor Brett Neilson (Western University of Sydney) provides a basis for mapping struggles against the changing forms of dispossession and exploitation enabled by massive mineral extractions.

Also the research fellow and head of office at the Berkeley University of California, Andrea Westermann, analyzes the metaphor of waste as a technofossil of unknown futures in her recent essay "A Technofossil of the Anthropocene", published in Power and Time by The University of Chicago Press.

In geology, Cobalt is defined as a ductile and malleable white metal that occurs naturally in the Earth's crust. It also confers a beautiful blue colour, a property that has been profusely exploited throughout the history of art to colour glass, ceramics and textiles.

In ancient Egypt, cobalt compounds were used as a coating surface in sculptures, temples, sarcophagi and burial vaults, as blue was considered the colour of the heavens and thus represented the universe.

In pottery, cobalt blue has been a hugely popular material in surface decoration, as the cobalt pigment is one of the very few that can withstand the highest firing temperatures that are required, especially for porcelain, which partly accounts for its long-lasting popularity.

Blue and white decoration first became widely used in Chinese porcelain. Traces of this porcelain wares are found at the beginning of the Tang dynasty (618-907), although it wasn't until the arrival of the Yuan dynasty (1271-1368), that the art reached perfection after the cobalt pigment for the blue began to be imported from Persia. In the early 14th century, mass-production of fine, transparent, blue and white porcelain started at Jingdezhen and during the Ming (1368-1644) and Qing (1644-1911) dynasties, the "blue and white" ware industry became increasingly important, not only within the borders of China but also in the international trade market. During the 18th and 19th century, coinciding with the rise of mass produced utilitarian objects during the industrial revolution, a significant part of the world's production of cobalt blue for the glass and ceramic industry was carried out at the Norwegian Blaafarveværket. In more recent times, we can also appreciate the use of blue cobalt in the porcelain works of Ai WeiWei, "The study of perspective in glass" 2018, Anish Kapoor "Blue Solid" 2006, or Maria Geszler "Meteorites and other poems" 2018. What is unprecedented, is the complicity of the mineral with our current technological time, becoming an essential element in the devices and infrastructures that enable even the most recent developments in new media (Parikka, 2015).

This recent increase of interest for Cobalt, sedimented in the deep time of geological processes, has caused certain regions of the world to become a socially, politically and economically unstable area. Such is the example at The Democratic Republic of the Congo, holding over 50% of global reserves and exporting around 50% of global cobalt production.

This research, is not going to be focused on a specific political conflict surrounding the current controversies of cobalt extraction, but It will be acknowledged as a relevant issue related to the historical context of the mineral that we can not simply obviate: Within the glamor, seduction and attraction caused by technological innovations, there is a reality of inequality.

THE TECHNO-CERAMIC OBJECTS:
A lithic testimony of modern society

A techno-ceramics object is an artifact conceived to explore possible forms of geo- subjectivities derived from the process of experimental artistic creation. It suggests a kind of resistance through the craft position, whether in its making, display or performance, to define the contemporary status of craft as a flexible, multi - positional and expanding methodology. I consider that the path to build this resistance cannot be found in the continual and ever increasing extraction of minerals from the earth's crust. Consequently, this proposal focuses on Urban Mining procedures in order to obtain the necessary information and skills to create the foundations on which to develop the insights on the prospects of sustainable ceramic objects.
Urban mining is the process of reclaiming raw materials from electronic waste products sent to landfill. On a conceptual level, it looks towards the waste generated by cities and urban environments as a valuable resource, using anthropogenic stocks rather than geological to meet the demands of manufacturing [1]. The name was coined in the 1980s by Professor Hideo Nanjyo of the Research Institute of Mineral Dressing and Metallurgy at Tohoku University. The methodology is an open approach where the source of materials for creative processes doesn't come from extractive activities, but from independent and autonomous processes of recycling.

The techno-ceramics objects will be developed from the discarded E-waste items found in the daily objects of our current digital society. By way of directing my intentions within the discarded electronic wastes available, I will focus on mobile phones as the main item to conduct the experiment. The first reason to select mobile phones is due to the high presence of cobalt in their batteries. By allowing a greater quantity to operate with initially, this will offer insight into smaller traces of cobalt in other Techno- ceramics in any future development studies. The second reason to focus on mobile phones is due to the increasing volume of mobile telecommunication devices in a state of imperfection and therefore at a stage of discard. With such a fast moving luxury goods product in a perpetual state of technological advancement and therefore outdated interest, there is a greater need to realise a resolve with this issue. Thirdly, mobile devices are extensions of intimate moments and human connections. A relationship is built, managed and stored within these hand held but life leading devices.
To reflect on specific ceramic processes the material qualities that affect our engagement with smartphones, It will be prior to register and articulate its chemical reactions and other influential aspects that might come along the process. At this point, the attention will not be focussed on whether the result is an experiment or an art object, but on the potentialities offered by the material's properties. Like a laboratory of ceramic empirical development. To conduct these early experiments, ceramic minerals will be used in the same percentage as we can find them in the composition of an electronic device. This blend will be tested at different temperatures in the kiln observing the melting point of each component and acquiring the necessary knowledge on the material's limitations and aesthetic possibilities. Different kinds of surfaces and shapes will also be taken into consideration to study the mineral's behaviour and sensibility towards the process. The test pieces will be properly registered and recorded in a documented structure for continued research. This database will enable future makers to quickly identify each mineral with its corresponding reaction and behaviour. Once these primary tests have been carried out and the results present a suitable and optimal degree of interest for the artistic development, the next step will be to start the recycling process from the devices in order to obtain the

1 - From "What is urban mining?" by Recycling Track Systems on the 21st of September 2021. https://www.rts.com/blog/what-is-urban-mining/

definitive raw material. Annexed to this paper, there is a file with illustrative examples of the very first tests conducted. In this document, the minerals related to the manufacturing process of an electronic device, such as Cobalt, Niquel, Iron or Aluminium, have been tested through ceramic procedures, following the compositional analysis of a standard mobile phone and applying the correspondent percentage contained. Note that this early test has not been executed with recycled minerals, but with the equivalent ceramic material.

Recovering cobalt from spent Li-ion batteries.
There are several theoretical and experimental studies about cobalt recovery from active mass of spent Li-ion batteries. After considering different methods, listed in the bibliography, I found the Granulometric analysis and comminution for a cobalt recovery process from mobile phone batteries conducted by Juan Pablo Sánchez Echévarri[2], Juan Fernando Betancur-Pulgarín[3] and Luz Marina Ocampo-Carmona[4] to be very descriptive and approachable from the artistic research perspective.

Collecting and sorting
Gathering a sustainable number of mobile phone batteries and sort them by model and manufacturer.

Initial Treatment: Discharging
Usually, the batteries are not completely discharged, therefore, to prevent self-ignition and short-circuiting, It is necessary to perform a discharging process following, in most cases, a specific discharge methodology proposed by Zhang et al. (2014), in which the batteries are subjected to an immersion process in a 5% p/p NaCl solution for a minimum time of 24 hours.

Dismantling and separation
Once the batteries were discharged completely, there is manual process of dismantling to obtain the batteries´ elements separately: anode, cathode, metal frame and remaining elements. Then, a semi-quantity compositional analyse by X-ray diffraction (XRD) of the cathode and anode element to estimate the range of purity and the concentration ranges of the compounds.

Comminution and crushing
Comminution operations are mechanical processes of rupture conceived to reduce an ore to minute particles or fragments, altering the physical state without altering its chemical nature. In general, these propose the reduction of the initial size in order to achieve a more homogeneous material by cutting with crushed equipment of shears or blades. This reduction in the size facilitates a electrometallurgical treatment in later stages in order to obtain metallic cobalt in pure form.

Filtration, grinding and sieving
Once all the grinding processes are completed, several grinding and sifting of different sizes are carried out, taking the material to its finest fraction. Subsequently, the percentage of cobalt recovered and its purity are classified and evaluated.
The study concluded by granting as a product, six samples rich in cobalt, of fine sizes ranging from 300mm to 45mm, recovering 67% of the initial cobalt.

CONCLUSION
The Techno-ceramics objects are laying the foundations for a necessary reconsideration of the role of crafts in this digital time, that broaden its traditional implications into new media providing a documented structure for continued research. Far from considering Cobalt's temporalities as a melancholic engagement to artistic reflection, this research explores the potential synergies between geological and artistic research methodologies, identifying commonalities and developing cross-disciplinary collaborations.

2 - Facultad de Minas, Universidad Nacional de Colombia; Facultad de Ingeniería, Universidad de Antioquia, Medellín. Colombia.

3 - Maestría en Ingeniería - Materiales y Procesos, Universidad Nacional de Colombia. Medellín. Colombia.

4 - Dpt. Materiales y Minerales, Facultad de Minas, Universidad Nacional de Colombia. Medellín. Colombia.

The final outcome will be an interdisciplinary structure of artifacts reflecting the future geological formations of a dystopian, yet habitable landscape. The project may result in a range of practice-led outputs, including the creation of ceramic objects, documentation, performance or public installations. Nonetheless, these are just some primary ideas. As my research carries on and the results become more visual, I expect the project to naturally adapt to the most suitable final presentation technique, exploring the potentialities of the method beyond one specific material to enact diverse actions and prove the historic emergence of environmental and social engaged discourses into the artistic research field. This work plan is already taking shape with the participation at the ARcTic South project, a partnership between FBAUL and KHIO in Oslo.

BIBLIOGRAPHY

Cornelius, H. & Angela, P. (2009) Contemporary Archaeologies: Excavating Now Peter Lang. University of Michigan. ISBN 978-3-631-57637-3

Mezzadra, S. & Neilson, B. (2017). On the multiple frontiers of extraction: excavating contemporary capitalism. Published online. ISSN: 0950-2386 (Print) 1466-4348 (Online) Journal homepage: http://www.tandfonline.com/loi/rcus20

Negarestani, R. (2008) Cyclonopedia: Complicity with Anonymous Materials. Melbourne. Re. Press ISBN: 9780980544008

Black, A. & Burisch, N. (2010) Craft Hard, Die Free: Radical Curatorial Strategies for Craftivism in Unruly Contexts. New York. The Craft Reader, edited by Glenn Adamson, 609-619.

Bourriaud, N. (2002) Relational Aesthetics. Les Presses du réel, ISBN 2840660601, 9782840660606

Bratich, J. (2010) The Digital Touch: Craft-work as immaterial labour and ontological accumulation." Ephemera 10:3/4: 303-318.

Callahan, M. B. (2016) Craftivist Clay: Resistance and Activism in Contemporary Ceramics. Toronto, Ontario, Canada. A thesis presented to OCAD University.

Gauntlett, D. (2011) Making Is Connecting. Polity Press ISBN0745650015 (ISBN13: 9780745650012)

Gogarty, A. (2008) Relational Ceramics. Craft Journal Vol 1:2. 51-86.

Glenn, A. (2009)Directions and Displacements in Modern Craft. Australian and New
Zealand Journal of Art 10:1: 18-33.

Leemann, J. & Stratton, S. (2016) Introduction to Gestures of Resistance. Museum
of Contemporary Craft, Portland, Oregon. http://mocc.pnca.edu/exhibitions/1278/.

Miller, D. (2011) Tales from Facebook. Polity Press ISBN0745652107 (ISBN13:
9780745652108)

Turkle, S. (2007) Evocative Objects: Things We Think with. MIT Press.
ISBN0262201682