248 EMERGENCE

PhD Research and Training proposal

1. EXCELLENCE (4 pages max)

1.1. Pre-proposal's context, positioning and objective(s)

America is the last continent where Homo sapiens sat foot sometimes during the Late Pleistocene. At the time Patagonia was covered by treeless steppes and witnessed intense deglaciation processes including the retreating of glaciers and the formation and catastrophic drainage of large proglacial lakes (Roberts et al., 2022). Over the last 90 years of archeological research in Central and Southern Patagonia, four main human occupation hotspots, were identified in the Central Plateau, the Pali Aike Lava Field, the Última Esperanza Área and the Northern Portion of Tiera del Fuego (Bird, 1938, Borrero and Martin, 2021; Martin et al., 2018; Paunero et al., 2007) (Fig. 1). The oldest radiocarbon ages from these sites suggest a human presence as early as ~13000 cal a BP in the Central Plateau. Further south, archaeological research from the Última Esperanza and Pali Aike regions indicates a clear human presence not before ~11000 – 10000 cal a BP, characterized by the findings of fishtail projectile points (Martin, 2013), or 2000 to 3000 years later. According to these ages, the first humans would have spread south from the Central Plateau as the climate improved after the harsh conditions imposed by the Antarctic Cold Reversal (14700 to 13000 years ago). If such a migration occurred, it is essential to frame the subsistence strategies and the mobility of these early inhabitants in the different hotspots. Recent zooarcheological and taphonomic analyses suggest that caves in the Última Esperanza Área functioned as logistic camps for animal processing, while caves in the Northern Portion of Tiera del Fuego, some 400 km further south, functioned as small base camps that were recurrently occupied (Labarca et al., 2025). But what about the Pali Aike Lava Field (PALF) hotspot? How did the first humans travelled there, in what conditions, when, under what type of subsistence strategy: butchering logistic camps or small base camps, and why? PALF remains the less studied hotspot of the four, and as such, is the missing piece that can provide a complete picture of the current four- hotspots migration model in Central and Southern Patagonia.

The PALF covers an area of 4500 km², stretching across the Chilean and Argentine border in southern Patagonia, north of the Strait of Magellan. The Pali Aike National Park was opened in 1970 in the heart of the Chilean volcanic field. It is home to numerous archaeological sites such as Cueva Pali Aike, Cueva de los Chingues and Cueva Fell, three exceptional examples of the way of life of the first inhabitants of the extreme south of South America (https://www.monumentos.gob.cl/patrimonio-mundial/tentativa/cuevas-de-fell-y-pali-aike).

Volcanic context: the PALF is a Plio-Pleistocene to Holocene monogenetic volcanic province containing more than 450 volcanic centers and ~100 maars, originating mostly from low-intensity eruptions. It forms a NW–SE trending belt about 50 km wide and >150 km long, representing the southernmost occurrence of the Cenozoic Patagonian Plateau Lavas (Corbella and Lara, 2008). Situated ~300 km east of the Andean arc, PALF occupies a back-arc position within the Magallanes Basin. Its eruptive products are alkaline, olivine-bearing basalts to basanites, with trace element signatures similar to ocean island basalts. K–Ar ages show that volcanic activity spans from ~3.8 Ma to the Late Holocene. Eruptive products include fissure-fed lava flows, scoria cones, spatter cones, domes, and numerous maars (500–4000 m in diameter). Volcanism developed in successive stages: early maar formation and lava flows preserved in valleys, intermediate spatter cones and soil-covered flows, and young cones and fresh lavas in the SE part of the volcanic field. Archaeological contexts provide additional constraints: volcanic deposits cover artifacts in Pali Aike Cave, indicating eruptions between 10000 and 5000 years ago. Sediment cores from Laguna Azul date maar formation to ~3400 cal a BP, while the Smithsonian Global Volcanic Program records an eruption ~5550 BCE. These evidences demonstrate that Pali Aike remained volcanically active during the Late Holocene, contemporaneous with human occupation of the area.

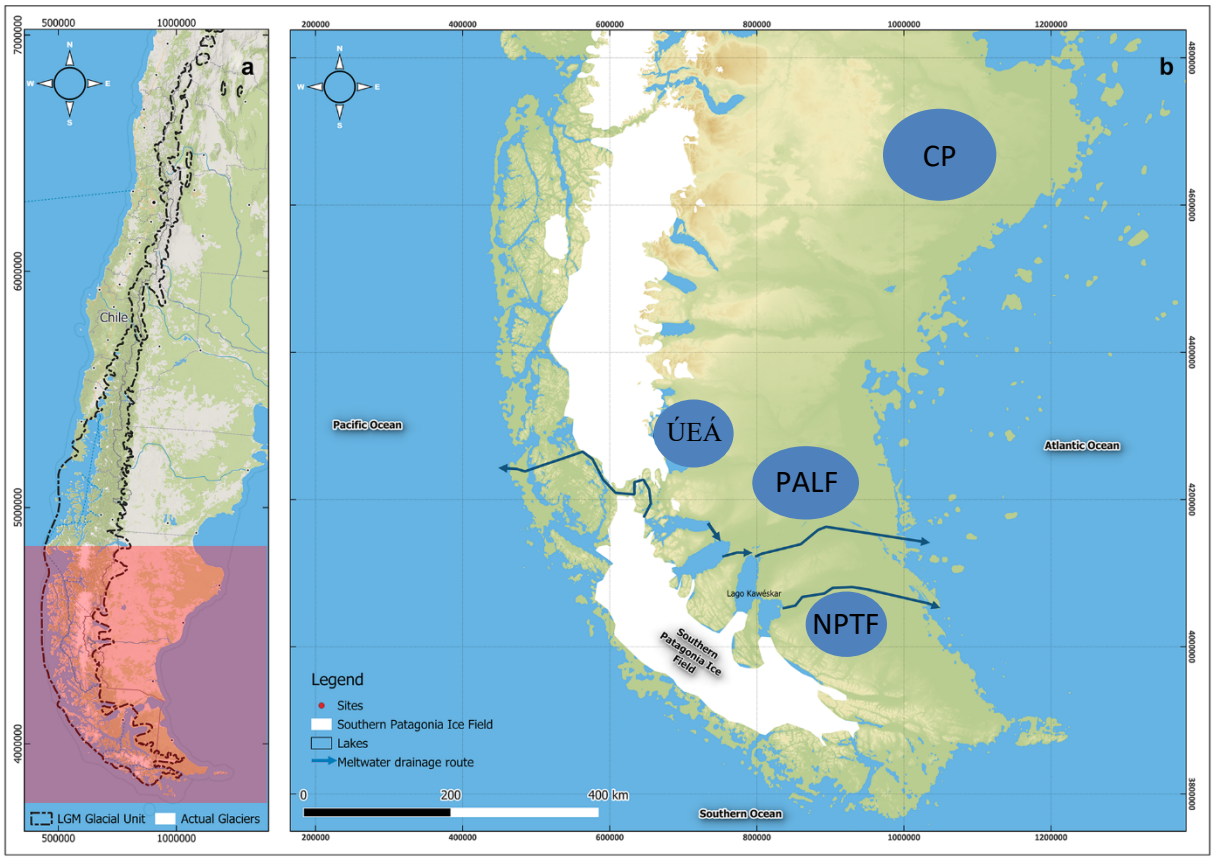

Figure 1: Southern tip of South America during the Last Glacial Maximum (~20000 years ago) showing the Patagonian Ice Field and the localization of the four hotspots corresponding to relatively dense occurrence of archeological/paleontological sites mentioned in the text (modified from Labarca et al., 2025). CP: Central Plateau; ÚEÁ: Última Esperanza Área; PALF: Pali Aike Lava Field; NPTF: Northern Portion of Tierra del Fuego.

Glaciation context: Glaciations affected Pali Aike between 3.5 and 1.0 Ma, although chronologies remain poorly constrained. Early Pleistocene glaciations deposited tills, moraines, and gravels derived from glaciers advancing east from the Southern Patagonian Ice Field towards the Atlantic via the Strait of Magellan, Seno Skyring, and Seno Otway (Davis et al., 2020). The volcanic and glacial records overlap (3.78–0.17 Ma), suggesting possible and complex glacio-volcanic interactions (Mazzarini and D'Orazio, 2003). Evidence includes basalts overlain by glacial deposits with K–Ar ages of 1.24 ± 0.3 Ma in the Río Gallegos valley (Mercer, 1976), as well as younger basalts (~0.17 ± 0.034 Ma) that are unaffected by later glaciations. Mercer (1976) concluded that the last glacial advances reaching Pali Aike area occurred ~1 Ma ago.

Some eruptions interacted with glacial and periglacial environments. For instance, the Potrok Aike maar truncated Middle Pleistocene terraces, with abundant water from meltwater and permafrost likely facilitating phreatomagmatic activity. The persistence of such landforms indicates limited landscape modification since the Middle Pleistocene. The Patagonian Gravel Formation (Rodados Patagónicos) constitutes today's plains, interpreted as glacial outwash from multiphased Pliocene–Pleistocene glaciations that extended eastward beyond the present Atlantic coast. These surfaces confirm that the "Greatest Patagonian Glaciation" (GPG) was not a single event but a multiphased process. By contrast, PALF was not glaciated during the Late Pleistocene. The Llanquihue Glaciation, the South American equivalent of the Weichselian and Wisconsin glaciations, did not reach as far east as the PALF as illustrated by the dated Seno Skyring former ice lobe (Lira et al., 2022), and its neighboring Seno Otway former ice lobe.

Overall, Pali Aike represents a unique landscape shaped by the interplay of volcanism, glaciations, and periglacial processes. Its volcanic activity spans the Miocene to Holocene, with evidence of eruptions

contemporaneous with human occupation. Meanwhile, multiphased glaciations profoundly influenced sedimentary and geomorphological records, leaving widespread outwash plains and periglacial features.

Archeological context: Southern Patagonia represents the southernmost frontier of Late Pleistocene human migration in the Americas and provides early evidence for possible human–megafauna coexistence (Martin and Borrero, 2017). Recent work has focused on endogenic caves ("sealed" cave) with little or no evidence of human presence, offering exceptional opportunities to study faunas predating or coinciding with human arrival. Systematic surveys identified significant assemblages in caves such as Cueva del Puma and Cueva de los Chingues (Prevosti and Martin, 2013). Hypotheses about extinct large felids, previously based on bone marks from Cueva Fell, were confirmed with discoveries of extinct panther. Studying human–carnivore interactions is therefore critical to understanding human emergence into Patagonian ecosystems and it potential impact on large carnivore extinction (Martin, 2013). However, the interaction between the first human groups colonizing Patagonia and the megafauna remains poorly understood. Furthermore, the climatic and paleoecological evolution of southern Patagonia during the Pleistocene/Holocene transition appears to have impacted human and animal occupations, as documented by large fluctuations in evidence of human occupation over the last 13000 years.

The overall objective of this doctoral research is to build a comprehensive framework to interpret the landscape and paleoecological evolution of the PALF in relation to the geoarchaeology of the sites attesting the presence of the first human groups in Pali Aike. More specifically the objectives of the project are to:

- Understand the site formation processes in Pali Aike during the Late Pleistocene–Holocene transition,
- Establish robust chronologies for the geomorphological and palaeoecological context of sites related to the early peopling of the PALF.

To achieve these goals, geomorphological studies will be conducted on multiple scales. Off-site (offside the archeological sites), the aim will be to distinguish between glacial, volcanic, fluvial, and wind-blown morphologies and structural characteristics in order to gain a better overall understanding of the landscape of Pali Aike National Park and its surroundings. The discrimination of morphologies will be based on field observations and surveys, analysis of satellite images (Pléiades) accompanied by photogrammetric surveys (drone images), and will be transcribed into geomorphological maps. At the on-site level (on and directly around the archeological sites), the objective is to obtain detailed archaeo-geomorphological maps that will provide a common basis for discussion among the research team, bringing together geomorphological, archaeological and paleontological data.

In addition, the methods used will contribute to contextualizing the new archaeological deposits and records studied, understanding the taphonomy of the bones of extinct megafauna, and identifying the processes of burial of archaeological archives. These complementary areas of work will enable us to define relevant dating methods in order to construct a robust chronology of the formation and diachronic evolution of the living environment of the initial human and extinct megafauna (mylodons, panthers, camelids). To this end, in partnership with laboratories we will combine the following absolute dating methods: (1) radiocarbon (^{14}C) for organic material sourced from shallow core sediments, (2) cosmogenic isotopes ^{10}Be (on quartz bearing erratic blocs), ^{10}Be and ^{26}Al (on glaci-fluvial terraces), ^{36}Cl (on basaltic flows), (3) OSL (on glaci-fluvial and eolian deposits), and Ar/Ar (on volcanic products). In addition, this cross-referenced geochronology and paleoecological reconstruction will be compared with climatic and environmental data available from Potrok Aike maar lake (Zolitschka et al., 2013) in order to understand the adaptation of past populations and megafauna in a context of rapid environmental changes.

The originality and innovative aspect of the doctoral project is the combination of on-site and off-site data with cross-dating methods and relies on three factors: 1) the multidisciplinary nature of the

techniques employed, 2) the wide range of expertise within the project team: geomorphology, sedimentology, paleoecology, geochronology, geoarcheology, archeology and paleontology, and 3) the potential to improve existing geomorphological and paleoenvironmental datasets, as well as archaeo-paleontological site formation models, for the PALF.

After more than a century of research, the record of human and extinct fauna occupations in southern Patagonia remains incompletely understood. Incorporating information from both known sites (e.g., Cueva Pali Aike, Cueva Fell, Cueva del Puma) and newly discovered sites in the PALF will help to better understand the nature of human and megafauna occupations and the changing environmental conditions they experienced. The discovery of open-air locations will be only one of the outcomes of the geoarchaeological approach. Increasing knowledge of site formation processes and taphonomy will allow for more precise interpretation of the archaeological and paleontological record at Pali Aike. It will also enable a clearer distinction between archaeological and non-archaeological faunal remains, many of which have been recovered from so-called "sealed" cave sites (Martin, 2013). Geoarchaeological investigations will provide new insights into the potential for extinct fauna (e.g. mammal bones) or artefacts (e.g. Paleoindian tools, exotic rocks such as obsidian) to become trapped in natural depressions (e.g. basalt "bubbles") and lava tubes, as well as in buried peats or alluvial sediments (e.g. guanaco carcasses). Off-site studies of geomorphology, geochronology and paleoecology will provide new information on the timing of proglacial and periglacial events, postglacial fluvial and aeolian processes, and volcanic activity, as well as rates of landscape change in the Pali Aike region.

1.2. Interdisciplinary dimension of the project

This doctoral project is part of interdisciplinary collaborations that have been ongoing since 2019 between the two supervisors Vincent Rinterknecht (geochronology, glacial geomorphology, CEREGE) and Dominique Todisco (geomorphology, geoarcheology, paleoecology, IDEES) and since 2010 between Dominique Todisco and Fabiana Martin at the Instituto de la Patagonia, and the Centro de Estudios del Hombre Austral at the University of Magallanes (archeologist, paleontologist, UMAG) in Punta Arenas, Chile. These collaborations have given rise to joined geoarchaeological investigations in southern Patagonia, particularly at Cerro Benitez, in the Última Esperanza Área (Martin et al., 2012, 2015; Todisco et al., 2018; Girault et al., 2020; Çiner et al., 2022). The doctoral project will therefore benefit from the complementary experiences of the two supervisors and their colleague at UMAG.

The project is intended to be a continuation of the work undertaken in the Última Esperanza Área. It responds to a desire and a need to explore new sites within a different biophysical context in order to compare the geoarchaeological data recently acquired in the Última Esperanza Área. The PALF is a relevant choice as it is considered a hotspot for understanding the early settlements of the southern cone of South America. This project will complement the research of Fabiana Martin aimed at comparing archaeological, paleontological, and paleoclimatic data obtained in the Última Esperanza Área region with those from Pali Aike in order to understand the spread of initial humans in southern Patagonia at the end of the Pleistocene.

This doctoral project also aims to be innovative in contextualizing the first settlements in southern Patagonia. The multiscale and interdisciplinary approach will provide a better understanding of the nature of human occupation and megafauna, and their adaptation to changing environmental conditions during the Pleistocene/Holocene transition. The off-site geomorphological, geochronological and paleoecological approach will provide new information on the chronology of glacial and volcanic events and the landscape evolution of Pali Aike. Finally, this doctoral project, which is interdisciplinary in nature, is innovative in its combination of off-site (deposits) and on-site data, its diversity of dating methods and investigation techniques, and the multidisciplinary nature of the research team and partner laboratories.

2. IMPACT (2 pages max)

2.1. Expected impact of the project on the candidate's career

The proposed multidisciplinary doctoral project will expose the fellow to a large array of state of the arts research techniques. These includes remote sensing, satellite imagery sourcing and handling to produce digital elevation models and maps using GIS system. The *EMERGENCE* GIS system will be the central data base where all new and already published information will be catalogued and analysed. GIS has become a central tool in science as well as in administrative jobs (e.g. land management) and as such, GIS represents a valuable competence to master when thinking about a career in research or when looking for a job outside academia.

The geochronological aspect of the project proposes to use multiple dating techniques: cosmogenic nuclides (^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl), OSL, Ar/Ar, aiming at answering a simple but central question: when? Becoming familiar with these techniques could broaden the candidate future career prospect within academia. At CEREGE, the candidate will be surrounded by a thriving community of cosmogenic nuclides users that applies the technique to ice cores, rocks, as well as to sediment deposits.

Archeological competences will be developed during fieldwork in Pali Aike and at UMAG when the candidate will be seconded by our archeological colleague and her team. Archeological excavations require discipline, organisation, patience and a dash of resourcefulness. Just about what any employer is looking for when selecting the perfect job candidate.

Overall, the fellow will be exposed to and become familiar with a wide palette of techniques that will improve his/her overall knowledge and as the potential to broaden his/her ability to craft complex research hypotheses if following an academic career. Least but not last, the fellow will benefit from a wide international network of colleagues and collaborators while working on the project.

Our non-academic partner: the Corporación Nacional Forestal (CONAF), is the State-owned non-profit organization that manages the country's forest resources and national parks in Chile. Pali Aike National Park is administered by Neftalí Arriagada Aroca (park director) and his team of permanent and seasonal park rangers. Access to the park and to the archeological sites has been regularly granted to Fabiana Martin and her team as part of a mutual agreement between the park and UMAG. The fellow will have first-hand access to the role, duty and way of life of the park rangers that accompany daily the archeological team to the sites. As the fellow will spend a total of eight weeks (over a period of two field seasons) with the archeological team, plenty of time will be available for exchanges and mentoring with the accompanying park rangers. These periods of exchanges have the potential to trigger career prospects for the fellow as national parks are world-wide attractions readily available in many countries.

2.2. Expected impact for the thematic axis

Initial human colonization of southern South America remains a fascinating question about how our species defied open landscapes and harsh natural conditions to reach southern Patagonia. Identifying the environmental conditions in which the migration occurred is a key knowledge to understand why some hunter-gatherer sites functioned as logistic camps for animal processing, and other sites functioned as small base camps recurrently occupied, as evidenced by previous zooarcheological studies. The PALF, one of the four hotspots of attested early human presence, offers an exceptional natural laboratory to merged geomorphological, environmental and archeological data to advance our understanding on the initial human migration to southern Patagonia. The *EMERGENCE* project will directly contribute to the understanding of climate-landscape-early-society interaction in the southern tip of South America, aligning with SCHADOC thematic axes on climate change and societies and culture.

2.3. Dissemination, exploitation and communication activities planned

Mainstream scientific dissemination will take the form of communications to one national (Réunion des Sciences de la Terre, yearly Fall meeting) and one international (EGU, yearly Spring meeting) conferences to increase the candidate visibility in his/her research field and to promote professional networking while at the conferences. In addition, the PhD thesis will take the form of a collection of manuscripts aimed at publications in specialized journals such as Quaternary Science Reviews, Journal of Quaternary Sciences, The Holocene, following one of the possible doctoral thesis formats of AMU *Ecole Doctorale 251*.

A dedicated website will be developed to present the project, the participants, to post new findings/publications and to share experiences from field expeditions. The web page will be hosted within the CEREGE website under the *Géoarchéologie et archéométrie* page (https://www.cerege.fr/fr/sciences/axes-transverses/geoarcheologie-et-archeometrie/).

Based largely within the Pali Aike National Park, this doctoral project also aims to provide various heritage promotion materials to the Corporación Nacional Forestal (CONAF), which manages the Pali Aike National Park, with a view to popularizing science and promoting development for the park. The deliverables proposed to the National Park include 3D models illustrating the processes involved in the formation of the geoarchaeological context, as well as simplified maps showing archaeological, paleontological, geomorphological, and chronological data. These will be displayed in the park visitor center, while water-proofed explanatory panels for the general public will be disseminated at key sites (e.g. Cueva Pali Aike, Cueva de los Chingues) within the park.

3. IMPLEMENTATION (2 pages max)

EMERGENCE focuses on the detailed characterization of the Pali Aike Lava Field by mapping and dating landscape features, by shallow coring of maars and peat bogs for environmental reconstructions and how they relate to archeological findings.

Off-site investigations will focus on glacial, fluvial, aeolian, and volcanic features to reconstruct long-term landscape evolution using geomorphological mapping, subsurface coring, geophysics, paleoecology, and multiple dating methods. Cosmogenic nuclide dating will be applied to moraines, bedrock surfaces and lava flows to constrain exposure ages and surface processes. This approach will enable the reconstruction of glacial retreat phases, volcanic episodes, and postglacial erosional events. Complementary Ar–Ar dating of volcanic samples will further refine eruptive chronologies if needed. Periglacial landforms, such as relict sand wedges or ice-wedge pseudomorphs, will be examined and, where possible, dated using OSL to improve reconstructions of Late Pleistocene environments. Combined, these chronometric approaches will provide a robust temporal framework linking environmental dynamics with archaeological and paleontological records. Sampling strategy will be designed before fieldwork to optimize the sample collection and allow time for the secondment activity of the fellow (see section below).

Additionally, we will conduct off-site paleoecological investigations through palynological and diatom analyses of one selected maar and one organic (peat) sequences. Chronological frameworks will rely on systematic AMS radiocarbon dating of organic (non-cultural) material. Particular attention will be given to sites such as the Río Chico valley, adjacent to Cueva Fell, to refine reconstructions of past vegetation, hydrology, and ecosystem dynamics since the Late Pleistocene.

Archeological and paleontological investigations will be conducted by our Chilean colleague and will aim to identify new evidence of Late Pleistocene and Early Holocene human and megafauna occupations. On-site geoarchaeological investigations will integrate stratigraphic logging, facies analysis, granulometry, micromorphology, and geochemistry to reconstruct site formation processes during the Late Pleistocene and Early Holocene. On-site excavations will be the time and place of the secondment for the fellow. The secondment will be conducted for one month at the Cueva Pali Aike site in year one of the project and for one month at the Cueva Fell site in year two. The fellow will work directly under the guidance of our archeologist colleague Fabiana Martin, a world-renowned specialist, and will benefit from the professionalism of her dedicated excavation team.

We will provide on-site mapping by integrating drone-based photogrammetry, DEM interpolation, and GIS with the goal to generate high-resolution 3D models and topographic contours. We will restrict the mapping to only two archeological sites (Cueva Pali Aike and Cueva Fell) due to the 36-month time frame of the doctoral project. Newly recorded sites will be georeferenced in the *EMERGENCE* GIS. Geophysical surveys (e.g. ERT, EMI) will complement these analyses by identifying subsurface anomalies related to depositional processes, volcanic geology, or past human activity such as hearths (e.g. through magnetic detection). These non-invasive datasets will guide excavation strategies and help evaluate the archeo-paleontological potential of each site.

Ideally, the first year of the project will focus on the acquisition of new field data and the collection of rock samples, with follow-up work in the second year. Between the two field campaigns, preliminary laboratory analyses will be conducted. Fieldwork (6 weeks per year for the first two years) will be carried out in parallel with archaeological excavations and surveys conducted by our Chilean partner during the austral summer (December to March).

Logistically, the team will provide the fellow with all material, laboratory access and collaborations necessary to fulfill the project goals. For mapping purposes, the fellow will have access to the SIGéo center at CEREGE (https://sigeo.cerege.fr/). For geophysical (ERT, EMI, georadar, magnetometer), photogrammetric (drones) and coring investigations (portable motorized percussion core drill necessary for the paleoecological investigations) the material is readily available at IDEES.

Equipment for rock sampling is limited to a hammer and a chisel to avoid obvious cutting marks left by alternative sampling techniques such as rock saws or small explosives. The fellow will have full access to the Laboratoire National des Nucléides Cosmogéniques facilities at CEREGE for the preparation

and AMS measurements of the samples (^{10}Be, ^{14}C, ^{26}Al, ^{36}Cl). Ar-Ar dating will be done in the frame of our ongoing collaboration with the LSCE (CEA–CNRS–Paris-Saclay) since 2021. OSL dating will be done in the frame of our ongoing collaboration with the University of Tübigen since 2022.

Paleoecological analyses/biotic indicators (pollen, diatoms) will be done in collaboration with Emilie Gauthier from the Chrono-environment Laboratory, and in collaboration in Chile with Claudia A. Mansilla, Assistant Professor at the University of Magallanes (UMAG) and the Gaia Antártica Research Center (CIGA).

Archeological excavations and field logistics: access to archeological and paleontological sites (far from the nearest city of Punta Arenas, ~4 hour-drive), conducting excavations/surveys, and setting up local logistics (camping, transportation), whether within the boundary of the Pali Aike National Park (Cueva Pali Aike) of the Corporación Nacional Forestal (CONAF, our non-academic partner) or on private land (Cueva Fell), are made possible thanks to our Chilean partner in Punta Arenas (Universidad de Magallanes - UMAG, Instituto de la Patagonia, Centro de Estudios del Historia y Arqueología – CEHA). Our Chilean partner, through the FONDECYT project (2023-2026) led by Fabiana Martin (UMAG), is responsible for the dedicated team of local excavators as well as the paleontological and archaeological expertise.

The main challenges of the project are related to logistics and field access. Site surveys and sample acquisition may prove difficult as logistical constraints can limit or delay investigations. Access to certain sites (outside the national park) generally requires authorization from the landowners of local *estancias*; these authorizations have been successfully obtained by our Chilean partner over the last ten years. Some restrictions may apply due to sheep farming activities (field season corresponds to lambing season), but our colleagues at UMAG can assist in finding appropriate solutions.

Transporting geophysical and drilling equipment to the field can be logistically challenging and costly. We will benefit from the expertise of the CNRS Ulisse unit (https://www.ulisse.cnrs.fr/) which specializes in transport and logistics worldwide. While in the field, we will benefit from the support of the excavation team for transport to and from the study sites.

4. ETHICS SELF-ASSEMENT

A potential difficulty concerns the shipment of samples from Chile to France, which may be delayed by administrative procedures imposed by the Consejo de Monumentos Nacionales (CMN). The team has gathered over ten years of field experience in the region and we have managed to successfully export sediment samples for further analyses in France. As all archeological artefacts (tools, bones,…) are catalogued and kept at UMAG for further analyses, no exportation authorization is necessary for cultural samples.

The project is designed to have a minimal environmental impact. This will be achieved by collecting only small-volume and small-size sediment samples from archeo-paleonlogical stratigraphic sites, limiting coring in peatlands, employing non-invasive geophysical methods. We will plan field transport (4x4 vehicles) along carefully planned routes, in concert with local sheep-farmers, to avoid damaging the steppe ecosystem and to minimize disturbance to local fauna, particularly guanacos. Field expenses will be minimized by camping rather than relying on external facilities. To further reduce the carbon footprint associated with air travel, only two field missions (6 weeks each) will be organized, with resources pooled among partners.

5. REFERENCES

Bird, J. (1938). Antiquity and Migrations of the Early Inhabitants of Patagonia. Geographical Review, 28(2), 250-275. https://doi.org/10.2307/210474

Borrero, L.A. & **Martin, F.M.** (2021) Pioneer population nodes in southern Patagonian lands. In: Bonomo, M. & Archila, S. (Eds.) South American contributions to world archaeology. New York: Springer, pp. 159–183.

Çiner, A., Sarıkaya, M. A., Yıldırım, C., Girault, I., **Todisco, D.**, **Martin, F.**, Borrero, L., & Fabel, D. (2022). Terrestrial cosmogenic ^{10}Be dating of the Última Esperanza ice lobe moraines (52°S, Patagonia) indicates the global Last Glacial Maximum (LGM) extent was half of the local LGM. Geomorphology, 414, 108381. https://doi.org/https://doi.org/10.1016/j.geomorph.2022.108381

Corbella, H., & Lara, L. E. (2008). Late Cenozoic Quaternary Volcanism in Patagonia and Tierra del Fuego. In J. Rabassa (Ed.), Developments in Quaternary Sciences (Vol. 11, pp. 95-119). Elsevier. https://doi.org/https://doi.org/10.1016/S1571-0866(07)10006-3

Davies, B. J., Darvill, C. M., Lovell, H., Bendle, J. M., Dowdeswell, J. A., Fabel, D., García, J.-L., Geiger, A., Glasser, N. F., Gheorghiu, D. M., Harrison, S., Hein, A. S., Kaplan, M. R., Martin, J. R. V., Mendelova, M., Palmer, A., Pelto, M., Rodés, Á., Sagredo, E. A., Thorndycraft, V. R. (2020). The evolution of the Patagonian Ice Sheet from 35 ka to the present day (PATICE). Earth-Science Reviews, 204, 103152. https://doi.org/https://doi.org/10.1016/j.earscirev.2020.103152

Girault, I., **Todisco, D.**, Çiner, A., Sarıkaya, M. A., Yıldırım, C., Quiquerez, A., **Martin, F.**, Borrero, L., Fabel, D., Grandjean, P., Nehme, C., & Mouralis, D. (2022). ^{10}Be chronology of deglaciation and ice-dammed lake regression in the vicinity of the Mylodon Cave (Cerro Benítez, Patagonia, Chile). Quaternary Science Reviews, 278, 107354. https://doi.org/https://doi.org/10.1016/j.quascirev.2021.107354

Labarca, R., Prieto, A., & Massone, M. (2025). Late Pleistocene subsistence and settlement during the initial human colonization of southern South America: Faunal evidence of Cueva Lago Sofía 1 and Tres Arroyos 1, southern Patagonia. Journal of Quaternary Science, n/a(n/a). https://doi.org/https://doi.org/10.1002/jqs.70039

Lira, M.-P., García, J., Bentley, M., Jamieson, S., Darvill, C., Hein, A., Fernández, H., Rodes, A., Fabel, D., Smedley, R., & Binnie, S. (2022). The Last Glacial Maximum and Deglacial History of the Seno Skyring Ice Lobe (52°S), Southern Patagonia. Frontiers in Earth Science, 10, 892316. https://doi.org/10.3389/feart.2022.892316

Martin, F.M. (2012) Human-carnivore interaction at the end of the Pleistocene in southern Patagonia, Chile. Journal of Taphonomy, 10(3–4), 561–574.

Martin, F.M. (2013) Tafonomía de la Transición Pleistoceno-Holoceno en Fuego—Patagonia, Interacción entre humanos y carnívoros y su importancia como agentes en la formación del registro fósil. Punta Arenas: Ediciones de la Universidad de Magallanes.

Martin, F.M., **Todisco, D.**, Rodet, J., San Román, M., Morello, F., Prevosti, F. et al. (2015) Nuevas excavaciones en Cueva del Medio, procesos de formación de la cueva y avances en los estudios de interacción entre cazadores recolectores y fauna extinta (Pleistoceno final, Patagonia meridional). Magallania, 43(1), 165–189.

Martin, F. M., & Borrero, L. A. (2017). Climate change, availability of territory, and Late Pleistocene human exploration of Ultima Esperanza, South Chile. Quaternary International, 428, 86-95. https://doi.org/https://doi.org/10.1016/j.quaint.2015.06.02

Martin F.M., **Todisco D.**, Rodet J., Prevosti F.J., San Román M., Morello F., Stern C., Borrero L.A., 2018. The Cave at the End of the World. Cueva del Medio and the Early Colonization of Southern South America. In People and Culture in Ice Age Americas, New Dimensions in Paleoamerican Archaeology, Rafael Suárez, Ciprian F. Ardelean (Eds), The University of Utah Press, Salt Lake City, 1-12.

Mazzarini, F., & D'Orazio, M. (2003). Spatial distribution of cones and satellite-detected lineaments in the Pali Aike Volcanic Field (southernmost Patagonia): insights into the tectonic setting of a Neogene rift system. Journal of Volcanology and Geothermal Research, 125(3), 291-305. https://doi.org/https://doi.org/10.1016/S0377-0273(03)00120-3

Mercer, J. H. (1976). Glacial history of southernmost South America. Quaternary Research, 6(2), 125-166. https://doi.org/https://doi.org/10.1016/0033-5894(76)90047-8

Paunero, R.S., Frank, A.D., Skarbun, F., Rosales, G., Cueto, M. & Zapata, G. et al. (2007) Investigaciones arqueológicas en sitio Casa del Minero 1, Estancia La María, Meseta Central de Santa Cruz. In: Morello, F., Martinic, M., Prieto, A. & Bahamonde, G. (Eds.) Arqueología de Fuego-Patagonia. Levantando Piedras, Desenterrando Huesos… y Develando Arcanos. Punta Arenas: Ediciones CEQUA, pp. 577–588.

Prevosti, F. J., & **Martin, F. M.** (2013). Paleoecology of the mammalian predator guild of Southern Patagonia during the latest Pleistocene: Ecomorphology, stable isotopes, and taphonomy. Quaternary International, 305, 74-84. https://doi.org/https://doi.org/10.1016/j.quaint.2012.12.039

Roberts S.J., McCulloch R.D., Emmings J.F., Davies S.J., Van Nieuwenhuyze W., Sterken M., Heirman K., Van Wichelen J., Diaz C., Van de Vyver E., Whittle A., Vyverman W., Hodgson D.A. and Verleyen E. (2022) Late Glacial and Holocene Palaeolake History of the Última Esperanza Region of Southern Patagonia. *Front. Earth Sci.* 10:813396. doi: 10.3389/feart.2022.813396

Todisco, D., Rodet, J., Nehme, C., **Martin, F.** & Borrero, L.A. (2018) Les cavites du Cerro Benitez (Patagonie, Chili). Hypotheses génétiques glacio-karstiques. Karstologia, 67, 31–42.

Zolitschka, B., Anselmetti, F., Ariztegui, D., Corbella, H., Francus, P., Lücke, A., Maidana, N. I., Ohlendorf, C., Schäbitz, F., & Wastegård, S. (2013). Environment and climate of the last 51,000 years – new insights from the Potrok Aike maar lake Sediment Archive Drilling prOject (PASADO). Quaternary Science Reviews, 71, 1-12. https://doi.org/https://doi.org/10.1016/j.quascirev.2012.11.024