

LOUISA KING AND TAMSIN SALEHIAN

INTERSTICES 21

Cartographies of care— ecologic thinking-with the bio-geo-microscopic life of the West Antarctic

The paper responds to the geographies and ecologies of the distant polar south, West Antarctica, separated from the populated continents by a thick noisy zone of wind, wave and current. Deep-time reading and ecologic care practices are proposed as cartographic tools to trouble the fixity of claim-making. Antarctica is not a mute imaginary; the icy continent speaks loudly, calibrating the speed of Anthropogenic change, providing a planetary pulse, measuring accelerations in human extraction and excretion. To understand the voice of the Dry Valleys of West Antarctica demands new and critical approaches that extend techniques of physical and perceptual inquiry. How might we encounter the microworlds there, apprehend the small cries of tiny creatures muted by the noise of Western progress and howling winds, register the air-catching tentacles of soft vegetative organisms? This project imagines a renewed relationship with the ecologies of the Antarctic through speculative cartography that enacts strategies of care from-afar.

Mapping Antarctica

Maps are troubling objects, entrenched in imperial logic. The history of cartography in Antarctica follows a Western legacy of knowledge production for the expansion of empire, and consolidation of the authority of the north (Glasberg, 2012). Aristotle first suggested that an unknown expanse of land must exist in the far south, if for no reason other than as a counterweight to the land masses of the enlightened north (Aristotle and Webster, 2001). *Polus Antarcticus Terra 1639* (Fig. 1), by Dutch mapmaker Henricus Hondius, imaginatively proposed the southern half of the globe as swathed in unknown terrains. In the Enlightenment imagination, Australia, the fifth continent, and Antarctica, the sixth, were immense yet incomplete propositions: Cingulus Australis (The Southern Zone); Terra Australis Ignota; Terra Australis Incognita (The Unknown Land of the South); or Terra Australis Nondum Cognita (The Southern Land not yet Known) (Ross, 2003: 2). Drawn on a piece of gazelle skin in 1513, an Ottoman Era map credited to cartographer Piri Reis, (Fig. 2) depicts the rocky coastline of the Antarctic from beneath the ice, the oldest surviving map of the continent (Wilson, 1964: 15). These Western cartographic imaginaries attempted to determine the

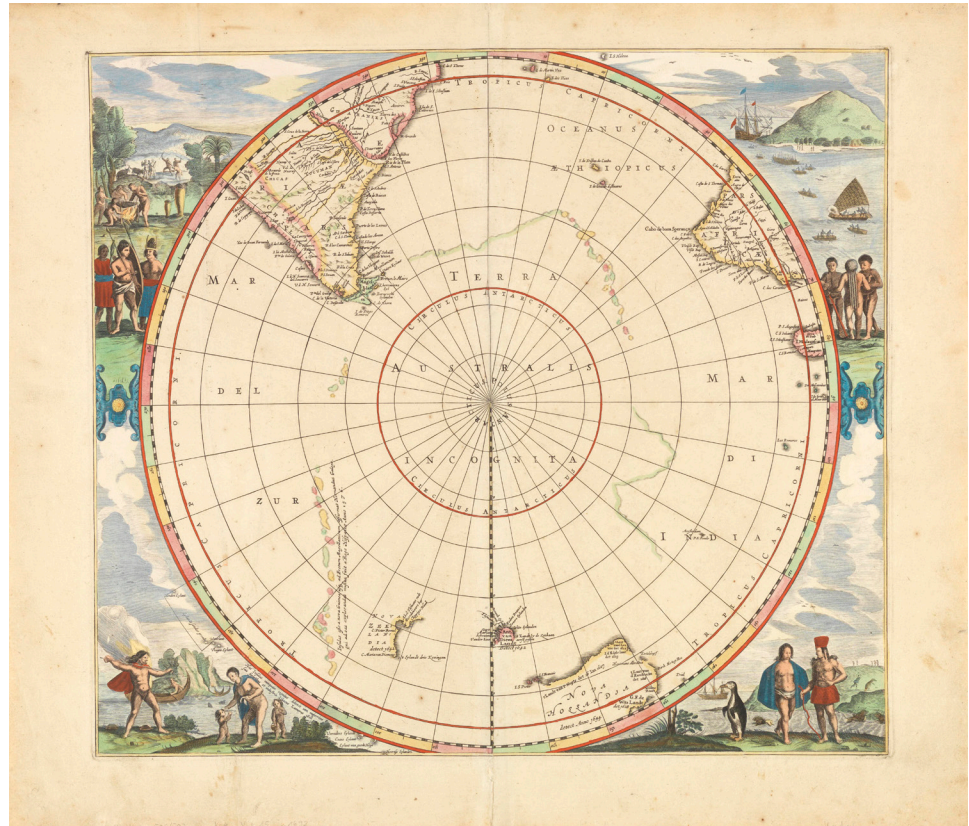


Fig. 1. Henricus Hondius (1639). Polus Antarcticus Terra Australis Incognita. [Cartography, Allport Library and Museum of Fine Arts, Tasmanian Archive and Heritage Office]

unknown polar south, but in doing so rendered it mute, as an inaudible terrain.

Antarctic cartography expanded during the first half of the twentieth century, was consolidated with the 1932–33 International Polar Year Antarctic expeditions, and realised in the territorial claims of the Antarctic Treaty System of 1959. Geopolitical and technocratic interests drove new forms of global claim-making (Glasberg, 2012: 6), informed by geographic positioning, geographic information systems (GIS), and remote sensing technologies. Mapping techniques were developed alongside this cultural backdrop of claim-making. The central role of traditional cartography is to determine the terrain, through setting the agenda for mapping its traits. Physical objects, mountains and glacial masses are associated with abstract traits: place names, borders, and political boundaries eclipse the presence of physical entities. The map's capacity to locate and name establishes relational dynamics between the mapper and the mapped whilst upholding the authority of the cartographer's gaze. Cartography is a universalising and normalising instrument of empirical objectivity, deploying exclusions and inclusions, establishing hierarchies and overlaying values on subject sites.

Worlding

Cartography assumes the map is a bodiless, unequivocal form of knowledge. Within this, and recognising that all knowledge production is situated somewhere, the politics of the cartographer's location comes into focus. The distanced and data-driven characteristics of GIS define it as a tool

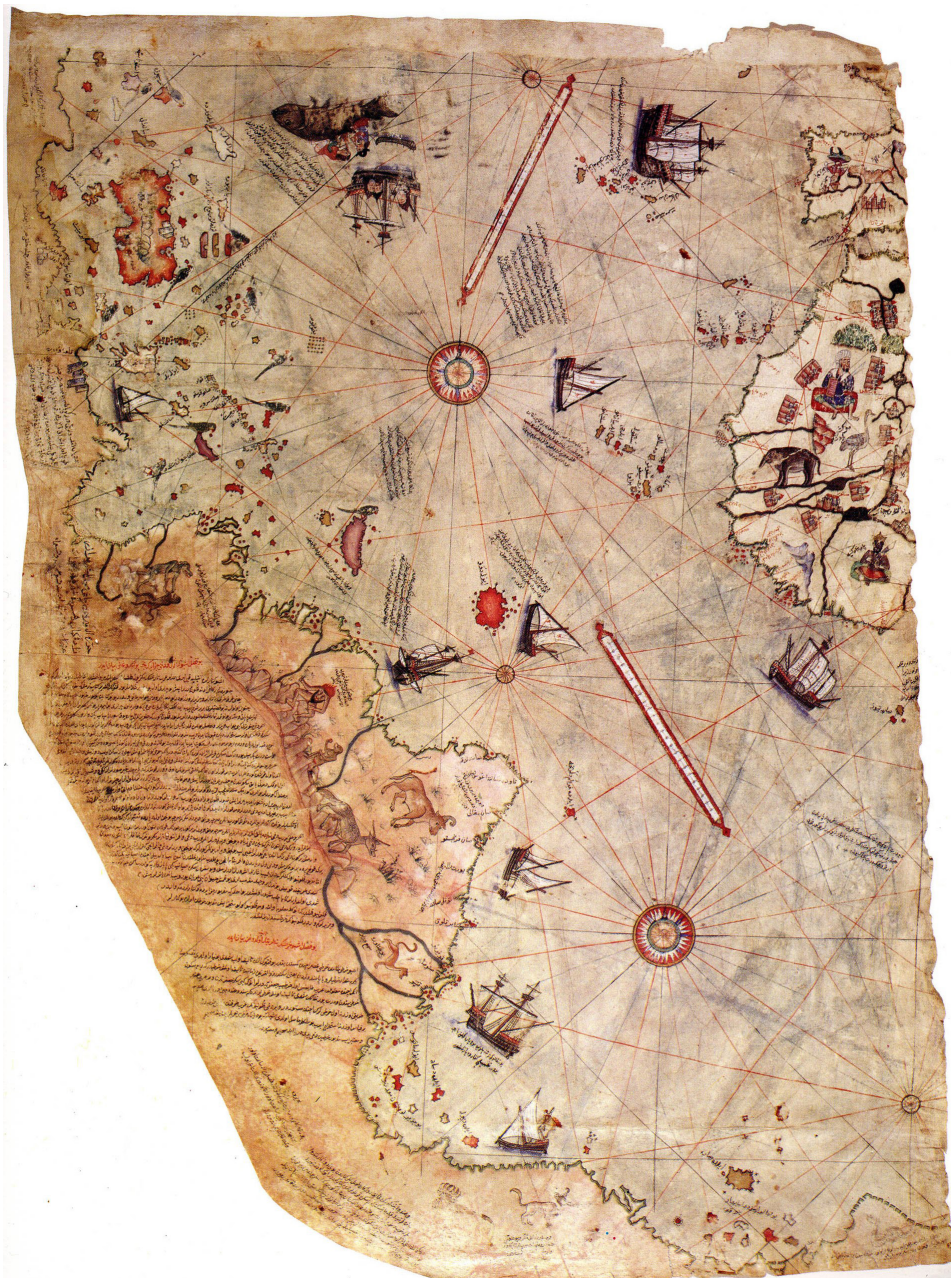


Fig. 2 Piri Reis (1513). Map fragment. [Cartography, Library of Topkapi Palace Museum]

for objective and empirical description, that assumes a subject as always able to be defined and located (Crampton & Krygier, 2006). Geographer Mei-Po Kwan interrogates the positivist observational epistemology of GIS, proposing that feminist geographies are ideally placed to reimagine the possibilities inherent in GIS technologies through feminist critical theory and practice (Kwan, 2002). Feminist geographies question assumptions of legitimacy, in forms of knowledge production, and propose embodiment and affect as productive challenges to the prevailing “removed observer”. (Pirani, Ricker & Kraak, 2020).

Research observation and monitoring typically happens far from Antarctica’s fragile and extreme landscapes—remotely sensed data and satellite imagery is transmitted to research institutes situated across the globe.

In a phenomenological framework, where physical touch and first-hand experience are given superiority over the virtual, this distance would signal an ethical dilemma (Braidotti, 2014, 327). A material ontological framing questions the authority of technological recording mechanisms and the individuated subject (as something “in the field” and “all-knowing”) and, instead, points to a collective approach where data is communal and material vibrancies connect across sites and sources. Interlacing feminist methodologies with Antarctic data unsettles the stability of conventional cartography and includes the ethical and political narratives of more-than-human others.

Critiques of mapping, along with the precarity of the quiet places suffering ecological collapse, suggest a need to rethink concepts of territory, including reimagining the tool with which it is observed: cartography. The creative mapping project described in this paper involved such reimagining. Life forms of the West Antarctic dry valleys were mapped, through a cartographic locating and representing that was also a process of material translation, a *thinking-with* ecologies (systems) and their geographies (locations). This concept of “thinking-with” is informed by feminist philosopher of science Donna Haraway’s approach to situated knowledge production, in which relational processes can express conditions for mutual flourishing and affective mattering (2016: 35). Thinking-with the other is an ontological condition of becoming-with. Thinking-with Antarctic ecologies is an encounter framed by *ecologic listening* to the other. Listening as an embodied practice is a type of situated knowledge, an approach to thinking-with prioritising small ecological interactions, an intimate performance of mutual “ongoingness”.

Ecologic listening requires an active, attentive openness to voices of the other, to tempos and volumes, miniature sounds and movements. When used as a tool to “think-with” ecologies and data, ecologic listening suggests open ways to tune in to other domains, allowing the act of listening to be informed by “outside inflections”. Listening in this case does not necessitate nor does it exclude the sonic—as hearing and listening are not mutually exclusive concepts. It is a call to attend to the quiet connections between things, to pay attention to the qualities of activity that form relationships, to recognise geologic intricacies and microscopic temporalities. “Listening, like speaking, is not neutral. Listening with care is an active process of intervening in the count of whom and what is ratified as concerned; it affects the representation of things, adding mediation to mediations” (Puig, 2017: 58). Ecologic listening draws from critical cartography, which deploys synthesis and speculation, to develop a radical practice that intensifies affectual imaginaries. It reorients the navigational potential of mapping to an ontological direction of thinking-with and an ecologic listening-with as modes of creative worlding.

Worlding is the collective attempt to reimagine and express the spaces of dwelling of both human and more-than-human worlds, a way of thinking together or thinking-with (the other). Worlding, in this sense, seeks to include the other or those left out of dominant narratives, to re-establish identity and places with a new form of claim-making. Åsberg, Thiele and Van Der Tuin recognise worlding as a “situated and materialising speculation” which “implies both the envisioning of a different world and a challenge to taken-for-granted pieces of knowledge by situating them in specific historical, sociocultural, material and bodily contexts.” (2015: 9) Worlding is an

ontological practice that recognises matter and relationships as heterogeneous, contextual, embodied, and embedded (Puig, 2012: 198), it is an act of care, grounded in feminist discourses of accountability (Puig, 2011). Donna Haraway’s call to actively reimagine a non-anthropocentric world through a multi-species, material-semiotic becoming-with, hinges on a stance emphasising intimacy without proximity (Haraway, 2007: 4). A speculative approach to care connects to this intimate yet not proximal worlding, via the multi-species patterns and intra-actions across distances (Haraway 2016: 2). Haraway reminds us that as we inhabit the world and the world inhabits us, we tell situated stories; “it matters what stories we tell to tell other stories with; it matters what knots knot knots” (Haraway, 2016: 12). The stories matter, as they speculate upon the politics and social dimensions of future worlds. An ethos of listening with care, to enable “speaking for subaltern epistemic things” (Watson, 2014: 935), underpins our disrupted mapping methods as tools of design that navigate novel forms of worlding.

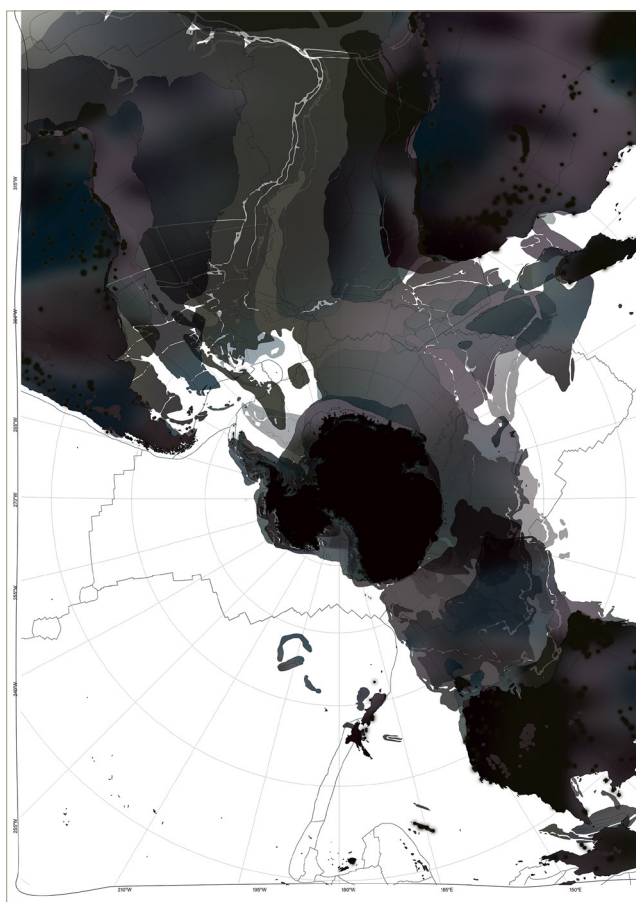
Reworlding Antarctica: Stony worldings

Taking in a prospect of Antarctica’s McMurdo drylands, a viewer might be perplexed. Their eye is met with exposed rocky landscapes, extensive glacial stone wash plains, brown, black, grey but not much white, not much ice. The absence of snow does not signal a less harsh environment than Antarctica’s frigid interior however. Rather, the exposed coastal terrain results from 300 kph katabatic winds exhaled down into the valleys, heating as they hammer down and dissipating almost all moisture in their passage. Still, the freezing, arid and depleted permafrost affords some species a favourable environment for growth. In this frozen desert, these creatures have developed through time an “earth/body” collaboration with Antarctica. Endolithic bacteria and extremophile mosses have been found living in the Dry Valley, sheltered from the dry air in the relatively moist interior and crevices of rocks.

The label endolithic refers to organisms living in or penetrating stone (rock); “endo” internal of lithos “stone” worlds. They colonise fissures and cracks in geologic material, forming tunnels as they move. Within stone, the endolithic are stationed to wait for opportune conditions to flourish. As autotrophic digesters, endoliths make their food by exploiting gas or dissolved nutrients from water moving through the fractured rock around them. The microorganisms bore into the rock, excavate the material substrate and create pore spaces for their growth. (Wierchos, 2006: 790) With the stone, the endoliths make spectacular unions as the rocks themselves conform to their body shapes—they consume and construct in collaboration with geologic processes.

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Fig. 3 Patrick Fitz-Hayes & Georgia Gamieson (2020). Geologic intricacies. [Cartography, UTS]



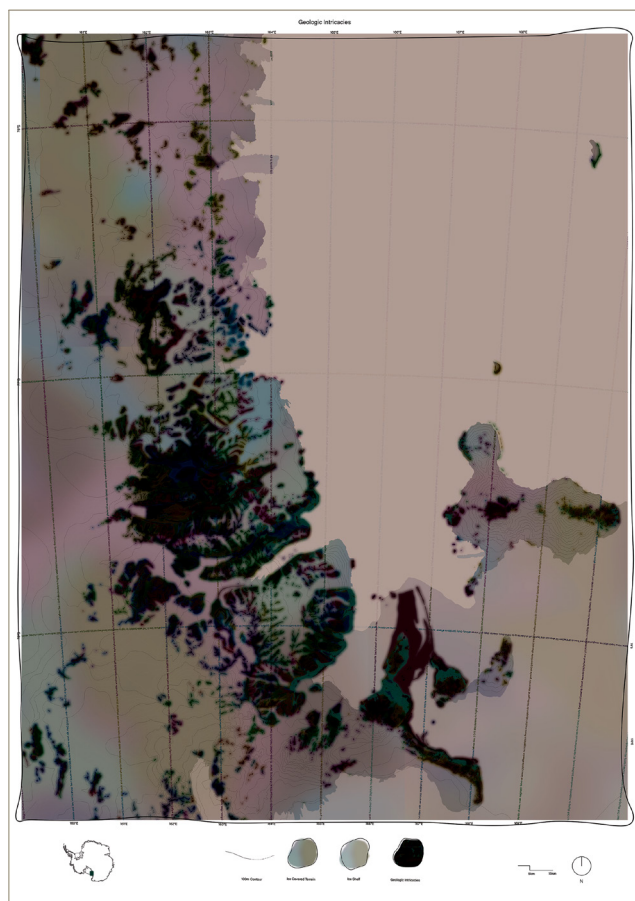


Fig. 4 Patrick Fitz-Hayes & Georgia Gamieson (2020). Tectonic shift and the extractive environment. [Cartography, UTS]

The map, *Geologic Intricacies* (Fig. 3), begins to chart the story of the endolith. These seemingly insignificant creatures have followed mineral-rich flows of matter since the Archaean Eon, 4,000 million years ago (ma), the time following the Big Bang when the Earth's crust had cooled sufficiently for continents to form, and the earliest known life to appear. These ancient life forms and geologies have witnessed deep pasts, and may signal unknown futures. To narrate these extreme communities in McMurdo, the mapping surveys the granitic and dolerite intricacies of the place, which resulted from tectonic collisions, long erosions and inhabitation by delicate organisms.

During the Mesozoic Era (200ma), Antarctica was the centre of Gondwana, the supercontinent that comprised the current-day South America, Africa, Antarctica, Australia, the Indian Subcontinent, Zealandia, and Arabia. The drawing, *Tectonic shift and the extractive environment*, (Fig. 4) calls forth the tectonic journey of Gondwana, as it fragmented in a clockwise process that propagated from the interior of Antarctica into the satellite archipelagos, now known as the Indo-Pacific region. Following the narrative of Gondwana through shifting climate and geology we see the flourishing and collapse of distinct life forms.

The Antarctic has brought with it, through those tectonic drifts, the endolith, an ancient primordial subject. Speculating on overlaps in tectonic plates, the map traces the endolith journeys in the McMurdo. The maps (Figs. 3 and 4) narrate the pervasiveness of microbial habitation within the gnarled apertures of rock, their extraction, excretion, and embodying behaviours that conform the soils and rocks themselves.

Gondwana's breakup began with the rifting of Africa and Antarctica, with lands crashing and tearing apart. The high cliffs of McMurdo, where the cold winds rush down, are the crumpled edge of that rifting event 220 million years ago. Nestled within the Jurassic dolerite rock of the rifted land is the current habitat of the endolith. Within those weathered folds of the rock, soft vectors in the drawings stage the habitat as a dark entity. Darkness in this map dampens the multiple layers of geologic deposits, allowing the intersection of biotic and abiotic worlds to become illuminated. Thin patching vectors undo the fixed precision of "the breakup" to make legible the habitat of extremophile communities.

As one of the extremely cold and dry earthly edges of existence, (O'Reilly, 2017), Antarctic micro-life still flourishes in the rugged escarpments of McMurdo. Mapping their flourishing followed lines of movement—creeping, exploding, crystallising, spitting, leeching, burrowing and breeding. Surviving on minute traces of iron, potassium, sulphur and carbon, the endolith remains dormant for most of the year. The interactions of the tiny and gigantic multi-species network entangle rock and organism in an ecologic commons. The drawing, *Predicting endolithic flourishing* (Fig. 5) records the relationship between rocks, substances

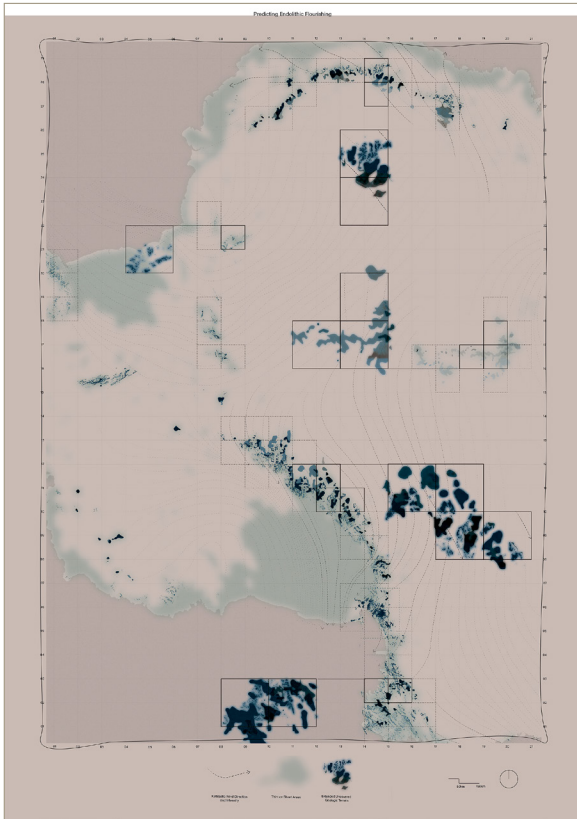


Fig. 5 Patrick Fitz-Hayes & Georgia Gamieson (2020). Predicting endolithic flourishing. [Cartography, UTS]



Fig. 6 Patrick Fitz-Hayes & Georgia Gamieson (2020). McMurdo Dry Valleys habitation study. [Cartography, UTS]

embodying deep time, and gales that sweep down the mountains, carrying nutrients that fall into the bodies of the extremophile. Encounters with wind and rock allow the endolith to flourish: a deep time sleeper, dormant in some cases for 10,000 years, slumbering long beyond human temporalities, awaiting suitable conditions, awakening in interglacial periods, living through Snowball Earth conditions and surviving greenhouse effects and ice ages.

Cartographic reworlding suspends conventional temporalities, yet reveals how the habitats of quiet places might divulge a new temporal awareness of an unstable climate. Intensifying the agency of drawing to map the endolith, the lines of the drawings hover between time past and uncertain futures, in a thickened present, a temporal state outside western narratives of progress that underlie much of conventional cartography's perceived use-value.

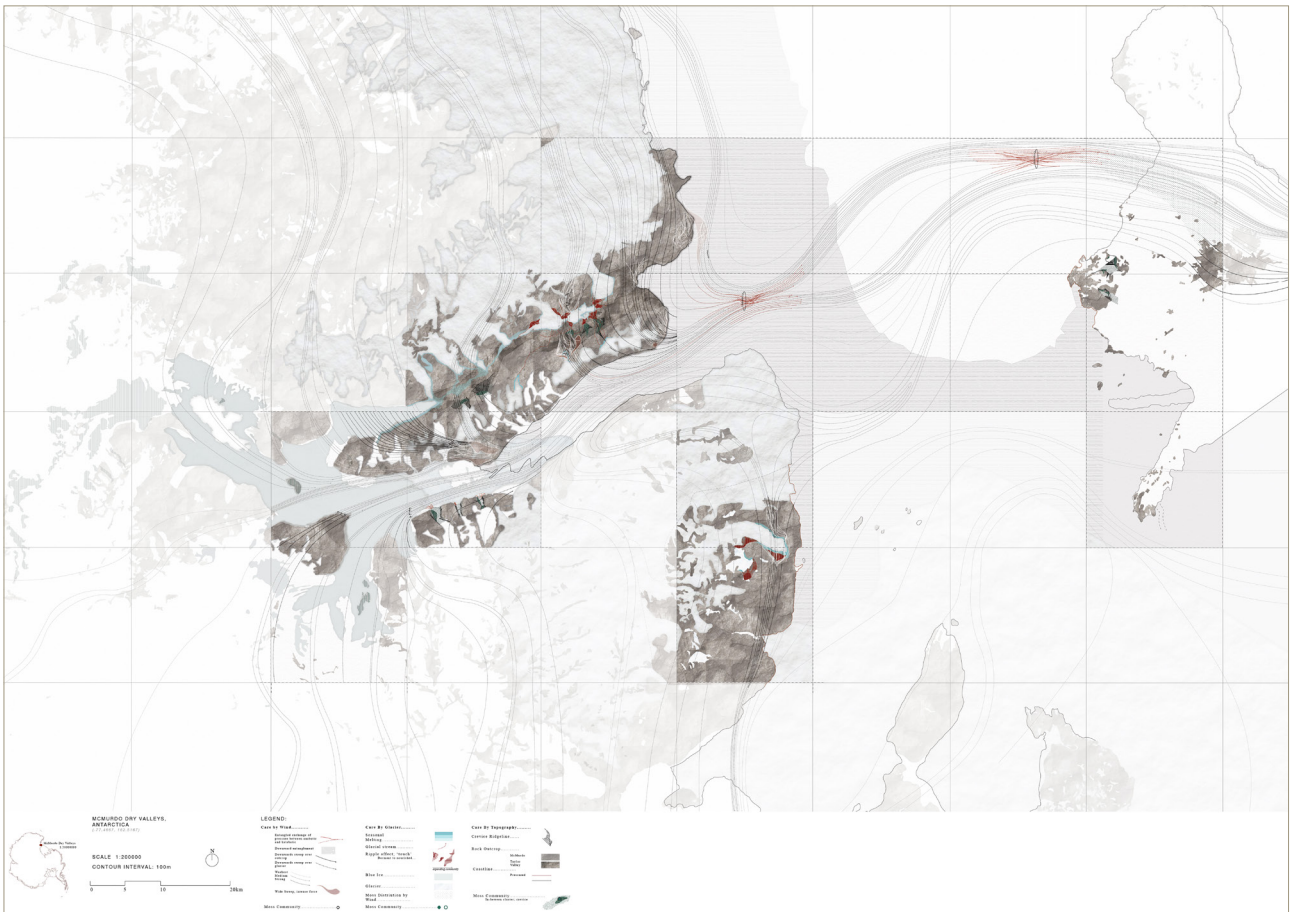
To map worlds is to reveal a context or background (Anderson & Harrison, 2010: 8). Re-mapping endolithic communities in McMurdo Dry Valleys, reframes their temporal and spatial scales which prompts questions as to climate oscillations and their impact on the uncertain future of the human. The maps' scale is intentionally large, mapping territories at 1:1,000,000 and greater. *McMurdo Dry Valleys habitation study* (Fig. 6) called for geology, the cryosphere, and territorial delineation to inform the mapping of this context. As a territorial claim delineates geography, cartographic borders define the fixed extents of governance. As we begin to understand the ubiquity of microbial habitation, this definition buckles. A new collection of maps blurs numerous unstable boundaries. In mapping the 'endolithic commons' a place of multispecies negotiation, integration

and confrontation emerges. Typically, maps in Antarctica fall into three categories; geology, cryosphere and territory; to map the habitat of the endolith, *Dry Valleys habitation study* mapped all three at once: rock, ice and space together.

Re worlding Antarctica: Ecologic listening

Cartographic fixing organises place, distance and spatial relationships into alliances (Vazquez, 2017). Mapping in terms of care calls for speculative methods that trouble the privileging of hierarchy and make an appeal for cartographic fixing to undo, rather than redo stratifying power structures. In Antarctic geographies, the distanced view is unavoidable. To remake hierarchies of fixing or to “unfix” Antarctic cartographies, thinking-with the microscopic worlds of moss through a considered ecologic listening, a method for recognising, interrogating, and working with this distance. Mapping the moss *Hennediella heimii* placed the subject of cartography within a set of relations which included the mapmaker as affected by the subject being mapped. Loraine Code defines an embodied approach as “revised modes of engagement with knowledge, subjectivity, politics, ethics, science, citizenship, and agency, which pervade and reconfigure theory and practice alike”. (Code, 2006: 24) With these concerns the “listening” cartographer operated through an embodied sense of listening-out-for as a tool to notice interactions between elements in the geography, paying attention to the complex relationships formed between the biotic and abiotic materials of landscapes.

Fig. 7 Alexandra Duff & Olivia Monteleone (2020). Threads of receptivity. [Cartography, UTS]

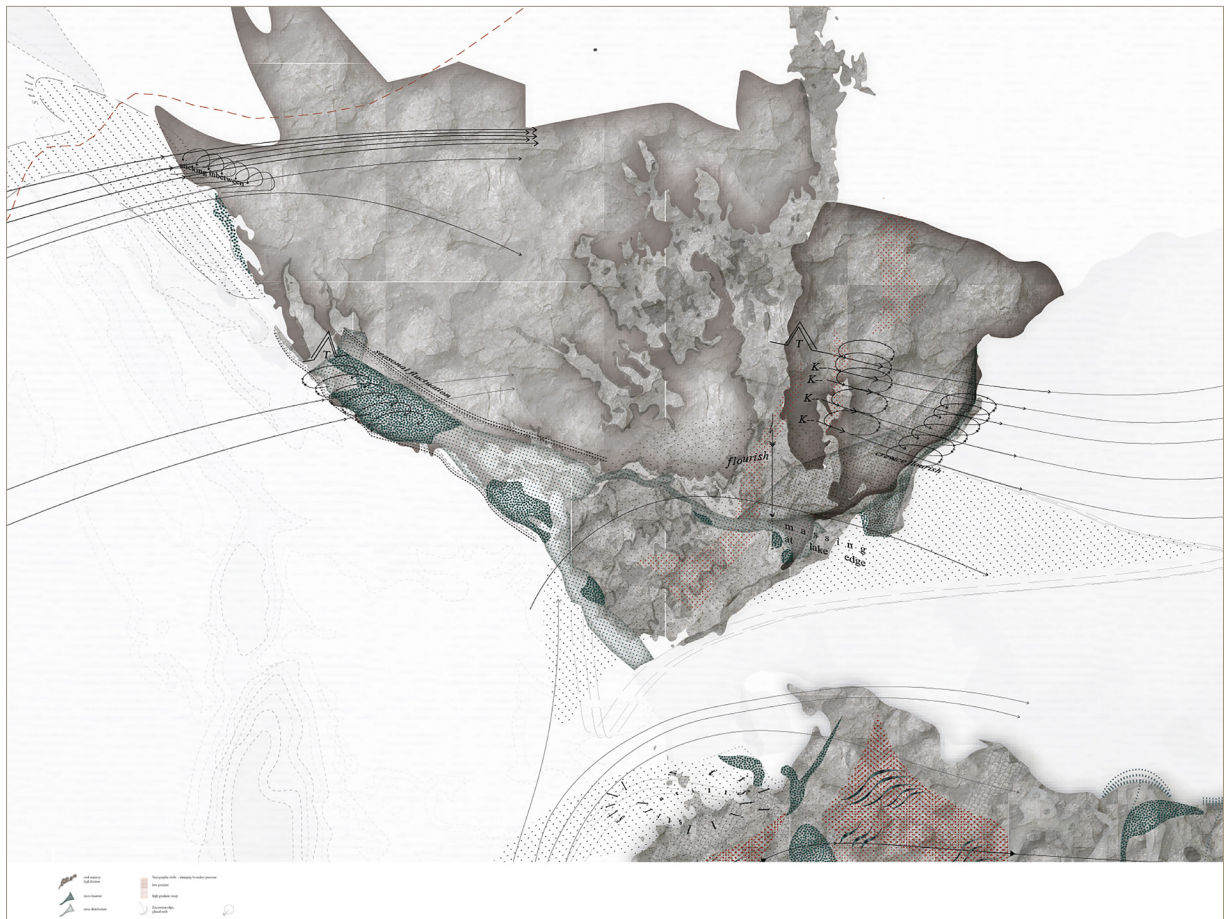


To think with moss is to get to know the world of moss, recognising the need for the researcher to become open to the physicality of the other. Moss grows through cellular layering, a slow expansion of the body. Cells don't exchange material in a traditional process of plant formation, rather each cell is discrete, absorbing and transpiring, drying and desiccating, a pulse of fast growth and equally fast decline in long, dormant winters. This process holds difference within the individual organism while simultaneously paralleling the totality of geographic interactions and the attendant affect each material enacts upon the other. In this time of vast anthropogenic reach, this practice of cartography is proposed to recognise the agencies of others and their precarity by making visible interactions that form ecologies of care.

The drawing, *Threads of receptivity* (Fig. 7) located the pulse points between moss colony distribution, katabatic winds and water. The map reorganises physical geographies into material conditions of care. Entangled interaction of katabatic winds and the hydrology of the valleys suggest care by topography, care by coastline, care by glacier, care by crevasse. This restructuring of territory performatively charts the liveliness of the abiotic worlds in the valley. In mapping these ecological processes, through a reimagined cartographic method incorporating their affect, they are given agency to disrupt the conventions of geographical species distribution mapping.

GIS data and scientific research are the main methods for getting to know the icy world. GIS is a tool that has been critiqued for its positivist and “god’s eye” view

Fig. 8 Alexandra Duff & Olivia Monteleone (2020). Knotted motion, behaviour map of *Hennediella heimii*, Canada Glacier, Taylor Valley (detail). [Cartography, UTS]



of landscape (Kwan, 2002: 650). The hyper-separation of the subject encouraged by GIS technologies is reflected on in the *Threads of receptivity* mapping through a stance of empathy as a care strategy. This requires the researcher to notice the multiple interactions that occur within moss ecologies. The drawing was used to attend to the points of interaction, informed by the biologic processes of moss, and bridges the gap between cartographers, data and site. Empathy to data requires a hyper-awareness of the material world of the moss, to embrace otherness and synthesise a sympoietic ontology.

The speculative mapping in *Threads of receptivity* aims to show the precarity of moss. Cartographic care practice must come, or extend, to domains other-than-human. The process of mapping *Hennediella heimii* attempts to rediscover the agency of moss as a mediator within the arid, polar desert (Fig. 8). Care is revealed as intra-action, a process of enhancement through material relationships. Karen Barad states intra-action is the reciprocal nature of agency, where all “things” are exchanging, diffracting, and working inseparably, recognising the impossibility of classically understood objectivity (2007: 141). Expanding mapping to include a range of nature-culture assemblages, which are generally not aligned, poses an alternative to the more familiar expression of datasets. *Knotted motion* (Fig. 8) draws the knotty relationships of moss as a form of claim-making, to reinstate the political situatedness of the non-human. Encapsulated in knotted motion (Haraway 2003: 6) surface conditions and materials absorb, shift and change as the community of plants becomes a material register.

The slow-growing body of Antarctic moss charts up to 500 years of wet and dry seasons, cataloguing atmospheric carbon levels absorbed by the plant’s cells and documenting particulates that travel through Antarctic atmospheres. The intricate surface structure can capture and hold material, creating conditions for microbial cascades of life as it performs a micro-geoengineering role within Antarctic landscapes (Ball, 2014: 652). This is not a benign record. The moss is intimately connected to international industrial processes and is a particularly sensitive bioindicator and climate register (Gabrys, 2018: 356). Organochlorides, DDT, and other toxins that move through the global food chain are all found in Antarctica’s moss. (Bhardwaj, 2018). This record expresses the slow violence of distant pollution and global politics. *Hennediella heimii* knots microscopic registrations of the climate history of the Dry Valleys in a cellular archive. Ice time—Antarctic time—disrupts the modernist project of Anthropos time and becomes a multispecies call to arms and action.

Care by moss: threads of receptivity (Fig. 9) charts material registers that catch, hold and extend the mossy bodies. Isabelle Stengers writes that ecologies are entangled modes of coexistence, strategies of co-becoming that can be expressed as a form of reciprocal capture—a dual process of identity construction that co-invents and is simultaneously identified by risk (2010: 36). These risks emerge through additive encounters and transformation. The wind that knots with moss is a harsh desiccating force, instantly drying outgrowing cells, yet this initiates a dormant period before freezing, enabling the moss to persist. Thinking with moss challenges human understandings of time and temporal scales; it also challenges the perception of bodily boundaries.

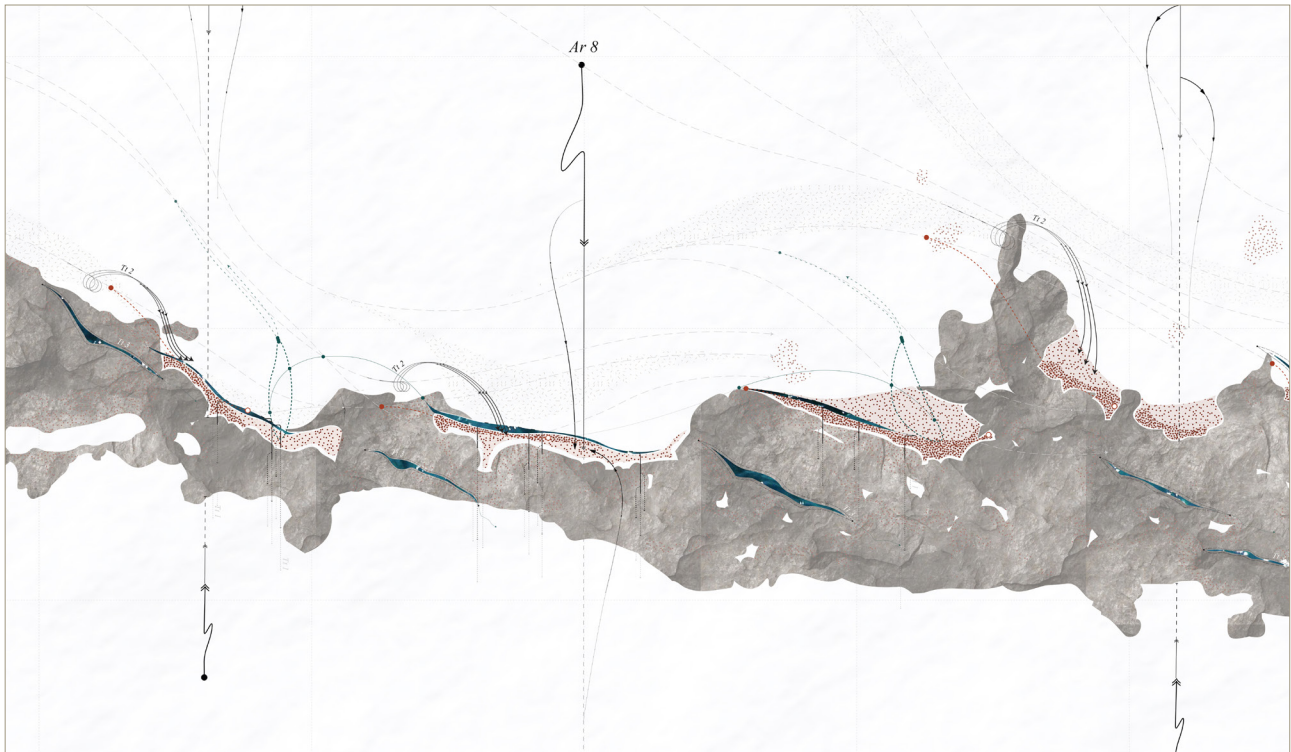


Fig. 9 Alexandra Duff & Olivia Monteleone, (2020). *Care by moss: Threads of receptivity* (detail). [Cartography, UTS]

Conclusion

Speculative cartographic practice has the potential to explore the ethical and political narratives of non-human entities and requires the mapmaker to consider the ontology of the other. As a decolonising practice, this constitutes a practice of care. Feminist thought reveals that knowledge practices are political: partial perspectives are present in all knowledge projects (Haraway, 1988), and thinking and doing are relational acts of material semiotic co-composition (Haraway 2007).

Deborah Bird Rose recognises reciprocal capture as stemming from alternate knowledge forms, a shift in thinking from linear discussions to alternative ways of comprehending time, space, and species interactions—a form of seeing “their realities” (2017: 52). This calls for an imaginative repositioning of the mapmaker within the polar environment, an ecologic listening for such things as moss, hearing its intimacy and cellular otherness. This qualitative and interpretive approach uses affect to gain knowledge hidden within the logic of datasets. This drawing of experiential knowledge is overlaid on the scientific data.

Thinking with mosses and distant Antarctic deserts engages with imaginaries of landscapes intimately connected to contemporary change. While ecologies in Antarctica appear remote, they express the physical reception of global material flows, a far from benign indictment of the reach of human worlds. In the highly consumptive space of the west, the noticing of traces and affects in a distant geography speaks to the quiet, persisting co-creative acts of landscapes. Looking to these quiet places proposes generative relationships for living in the Anthropocene.

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