



# Earth

caught in stone

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Art+Science Exhibition 2022

# Earth: caught in stone

Art + Science  
Exhibition Catalogue  
2022

Curated by  
Pam McKinlay

Art+Earth,  
a project in collaboration with  
the University of Otago, GNS  
and the Dunedin School of Art

# Earth: caught in stone

## *An Introduction*

Nau Mai haere mai – We invite you to attend and take part in the Art and Earth Exhibition. The exhibition brings to a conclusion the eighth Art and Science Project, which took “earth science” as its focus. Artists engaged with scientists’ research from GNS science, University of Otago (Geology, Geography, Zoology and Marine Science) and the Otago Regional Council. Working individually or in small groups to develop artworks, these have responded to the theme of “earth science” interpreted in a broad context.

According to *The Oxford Companion to the Earth*, the earth sciences encompass fields of enquiry from volcanoes to flood plains, diamonds to meteors, deserts to deep seas. Its diverse disciplines include geology, climatology, mineralogy, and oceanography and extend from mapping the features of the third rock from the sun to journeys to the centre of the earth.

The earth sciences explore the formation of rocks, as they are layered across geologic time, under restless pressures, ruptures and constant change. They engage with the macro and the micro, with chaos and order. And then there is the place of the human. How has our planet made us? How have the connections between earth systems affected evolution throughout deep time, and how have our use of natural resources changed the course of histories and cultures? What will our new horizons look like in the next geological era where people have become an earth shaping force?

Works in the exhibition responded to research in three broad areas. (1) Macro Scale, including research on: Te Riu-a-Māui / Zealandia (GNS), geospatial data and bathymetry of Antarctica and Zealandia (GNS), water on land action – coastal and river erosion (Geography), ecosystems and soil bioengineering (Zoology and Ecosystems consultants), Antarctica – iceberg debris (Geology), Zealandia’s past biodiversity (Paleobotany, Paleontology and Paleocology), sedimentology, current ripples modern and ancient (Geology), volcanology (Geology), “What lies beneath?” (ORC) and geological mapping (GNS). (2) Micro Scale: skeletal geochemistry and biomineralization (Oceanography), diatoms (Geology), rock fundamentals – zircons (GNS and Geology), Earth’s ever-changing magnetic field (Otago Paleomagnetic Research Facility). (3) Evolution: phylogeny: dolphins of Zealandia (Palaeontology), evolution kumimanu giant penguins (Palaeontology) and petrified wood (Geology).

Join us as we look back to the earliest of times through to the constant nibbling of Hinimoana at the shores of Papatūānuku. We look forward to sharing this exhibition with you.

Pam McKinlay, Jenny Rock, Bryce Peebles.  
Project co-ordinators 2020.

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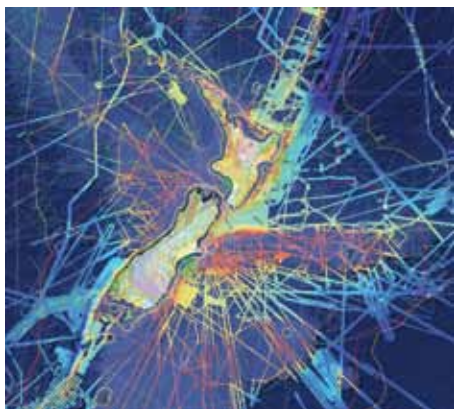
# Nick Mortimer

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Scientist

## *Te Riu-a-Māui / Zealandia*



Te Riu-a-Māui / Zealandia, Earth's eighth continent, has been a research focus of mine for more than twenty years. I am always seeking new ways to communicate Zealandia's place and importance in the environment.

This three-piece artwork is inspired by the title of a 2017 research paper "Zealandia: Earth's Hidden Continent" and by GNS Science's 2020 scientific map posters of Te Riu-a-Māui / Zealandia. On everyday maps the continent is invisible, hidden from view underwater. A few maps show sea floor mountains, ridges and plateaus that hint at underwater connections between islands. Geological maps fully reveal the continent's hidden rock foundations.



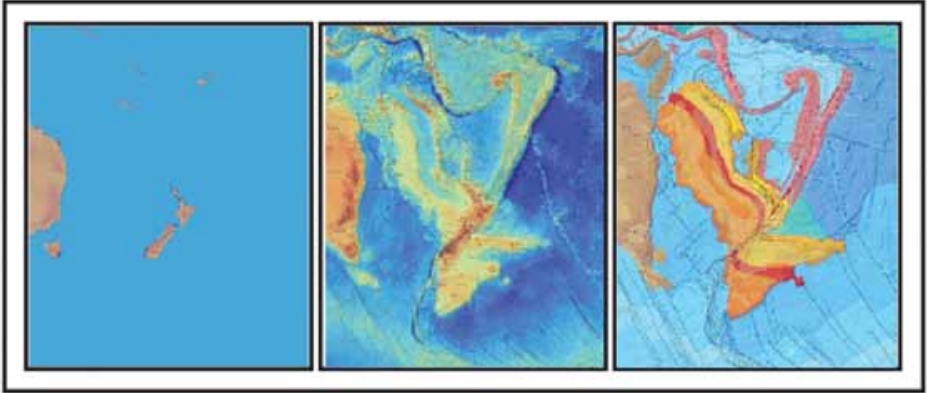
# Belinda Smith Lyttle & Jenny Black

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Artists

*Te Riu-a-Māui / Zealandia*



Conveying technical data in maps that are informative and aesthetically pleasing is an art, a craft and a little bit of science, too. In preparing the 2020 GNS map posters we paid particular attention to colour palettes, shading and patterns to show geological relationships and to highlight structural changes that are affecting our continent. This enables the maps to work individually or together.

For this triptych artwork, we have retained the original poster colours but have stripped out all text and technical information such as labels, map legends, and latitude and longitude lines. This leaves colours, shapes and textures to speak for themselves. The viewer is invited to realise just how much of our natural world is hidden and ponder discoveries still to be made.

# Belinda Smith Lyttle

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Scientist

## *Reference point – point of reference*

Any location on the face of the earth can be described in different ways, based around interest and frame of reference. An environment might be described as humid, arid, frozen. Vegetation can be noted as lush, dense, microscopic or perhaps fossilised. Geographic position can be described in many ways; noting places along a route, distance travelled in a known direction, location on a geographic grid.

Using gridded information about geographic position, maps can show spatial relationships that can be difficult to convey in words; the measurement of height on the surface of the Earth (elevation) or the measurement of the depth to the seabed (bathymetry). Modern use of satellite altimetry, airborne radar survey, and seismic sounding data provide information that could only be guessed at in the past and can be deployed across the amazing vast frozen landscape we know as Antarctica.

Extensive use of high-resolution elevation data has been used to assist more accurate mapping of the rock outcrops exposed at the surface of the ice. New digital data provides insight to the depth of the ice in East and West Antarctica and shows the surface of the bedrock below the ice. Bathymetry reveals the relationships of adjacent land masses such as South America or Zealandia recorded in spreading fault zones on the seafloor.

Why the concern with Antarctica? The southern continent is a major driver of world climate, understanding patterns of change in Antarctica must inform decisions made by all of us. The unique landscape and fauna are beautiful, and the vastness of the Polar Plateau is awe inspiring. Antarctica shares ancient tectonic roots with Zealandia, Australia, Africa and India.

Truly, we are all in this together.

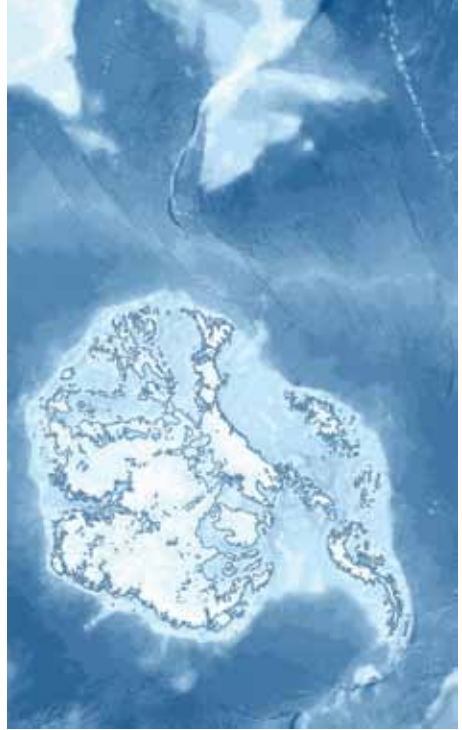


Photo credit: Cliff Atkins, Finger Mountain and the Taylor Glacier (Ferrar Dolerite, Beacon layers).

# Down the Rabbit-hole Art Collective 2021

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Artists

## *Emergent Seas – the bedrock of Antarctica*

Cartographer Belinda Smith Lyttle has spent years exploring the depiction of known qualities and quantities of surface in the frozen continent. For this project we embarked on a series of conversations about what the manipulation of digital elevation data would reveal visually about Antarctica's geological past. It quickly became apparent that the scale at which she was working was enormous and that simplification of the data would be necessary to draw out the striking changes in topographic relief from submarine bedrock to the Antarctic Plateau.

In the final work there are three light boxes. Two underlit woven tapestries relate to the landscape around the Taylor Mountains in Victoria Land. One depicts a dramatic exposed escarpment and the second is a white on white response to the fields of snow and ice in the glacier flows that cascade around and over mountains from the plateau to the sea.

The third light box is an LED work with a play on words around the idea of "emergent seas". With some of the ice stripped off we can visualise Antarctica as a continent surrounded by a chain of outer islands. Beyond the outer Antarctic archipelago we get glimpses of the major rifts in the bathymetry of the sea floor and track these towards the partly submerged continent of Zealandia and neighbouring Australia, all of which once made up the mighty continent of Gondwana Land.



Down the Rabbit Hole Art Collective 2021 (Pam McKinlay, Henry Greenslade, Leonora DaVinci),  
*Emergent Seas – the bedrock of Antarctica*, three light boxes at 680 x 1080mm, weaving, LEDs, Arduino,  
engraved opal Perspex – with thanks also for advice from Hannah Joynt and Ken Wyber EPIC centre.

# Simon Cox

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Scientist

## *Tūrangawaewae*

Tūrangawaewae is one of the most well-known and powerful Māori concepts. Literally tūrangā means 'standing place', and waewae 'the feet', thus it is most commonly translated as 'a place to stand'. But simple translation misses a deeper spiritual meaning. Tūrangawaewae are places where we feel connected and empowered. They are our foundation, our place in the world, our home. Connection to place and the whenua (land) is fundamental to Māori identity. It shapes our thinking, our way of being, our priorities and values.



Warrington Beach where Simon Cox recorded a 'stream of consciousness' of how an Earth Scientist views, reads and thinks about the landscape.

Connection to the land is also a concept well-known to

Earth Scientists. It forms a large part of their daily lives and is often a *raison d'être*. After more than three decades mapping geology and observing landscapes, the way I understand and 'read' the landscape has gradually evolved. While trained initially to see a hard, static, old and 'timeless land' of hard rocks and deep geological time, New Zealand's active tectonics and Natural Hazard events have shown me a more dynamic, lively, and dramatic set of processes that shape Papatūānuku (mother earth). But how might the 'spirituality' of tūrangawaewae and connectedness be captured, quantified or represented? Is it possible that art can show some of the depth, complexity and layering of thought that enables scientists to feel empowered to provide recommendations and advice?

The exhibit 'Tūrangawaewae' captures a spiritual side of Earth Science and a connectedness to the landscape that will not be found amongst rigid scientific manuscripts and equations. As a collaboration between art and science, its concept may have been complex but its execution relatively simple. While the world locked down and turned to online-only relationships during Covid, I recorded a stream of consciousness and immediate thoughts as I looked at, and read, the landscape. Warrington beach, where I live, near Dunedin city provided the setting for physical walks and mental wanderings. A set of 'online lectures' were created from views to the East, South, West and North outlining some science of tectonics, earthquakes, sea level rise and climate change across Te Waipounamu – the South Island of New Zealand.

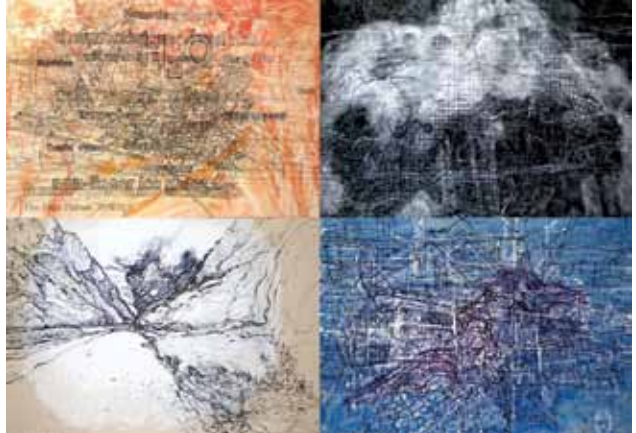
# Sarah Shackleton

Artist

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*Tūrangawaewae*

Although living in Spain on the other side of the planet, Te Waipounamu was also my birthplace. It is a place where I have stood, have family and am still very connected to. Projecting the videos on the wall, I dissected the lectures into a series of complex lines, shapes, colours and textures, reconstructing the science into a chaos of layers on canvas. Almost like an experiment itself, Simon teased me with images and views with potential to evoke an old sense of belonging. As I painted the land of my birth and layers upon layers of the science behind it, my connectedness did indeed evolve. All the while the artistic side of the project was both recorded and mirrored in video.



Represented by five large canvasses and digital recordings, *Tūrangawaewae* was an art and science collaboration that evolved through the stratification of geological processes, landscape evolution, scientific thoughts, online lectures, painting and drawing, digital editing and artistic expression.

Above (Clockwise): East, South, North and West, 1300 x 1950 mm acrylic on canvas works created by Sarah Shackleton in response to Earth Science lectures that were projected onto the canvas. Each was filmed as it was created. A compilation of the film will be projected in the exhibition. Also showing in Zaragoza, Spain in "S.A. de Próimos" (Encounter between Art + Science) 2021.

# Jasmine Mawson

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Scientist

## *Brook Street Terrane*

Geologic time is vast. Around 250-290 million years ago, a subduction zone off the edge of the ancient supercontinent of Gondwana produced a chain of island and submarine volcanoes. These volcanics would, much later, become known as the Brook Street Terrane.

Subduction occurs when tectonic plates collide and one plate sinks beneath the other into the mantle. Molten rock formed through this process finds its way up to the surface and produces a line of volcanoes.



My research focused on the eruptive processes of a sequence of volcanic rocks in Southland, a snapshot across a thin sliver of geologic time, perhaps a scant few hundred years or less.

These volcanoes grew from the seafloor, producing explosive eruptions and lava flows. Some built up enough to form islands, while others remained underwater. Underwater, the outer surface of the lava cools quickly to produce a skin that protects the lava inside, forming budding, bulbous pillow shapes. Elsewhere, lava is fragmented in the sudden shock of cold water, or by flowing down steep slopes. A new generation of lava burrows under these fragments, expanding the volcano.

About 230 million years ago, another subduction zone scraped the Brook Street Terrane onto the edge of Gondwana. 145 million years later, New Zealand split from the supercontinent and shifted to its present-day position, deforming along the Alpine Fault and displacing the Brook Street Terrane along its length.

Geoff's art speaks to the millions of years of history that put these rocks where they are today.

# Geoff Wyvill

Artist

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## *About Time*

Jasmine's research has examined the form, microstructure and chemistry of ancient volcanic rocks from a site near Riverton and revealed something about the process that created them. My work is inspired by the background to this research.

The pillow lavas of the Brook Street Terrane were formed in the deep ocean somewhere east of Gondwana in the late Permian era. My purpose has been to express my feelings and understanding of the vast process which over millions of years has created our islands and exposed these outcrops on the coast.



Work in progress: Verge escapement in its test rig and the Jacob's Ladder prototype.

We can remember events from the previous day and know when they occurred within a few minutes. We can use the growth rings on a tree trunk to estimate the age of the tree within a year. The clues as to the age of these rocks are more difficult to understand and experts seem to disagree. Estimates vary by 40 million years.

*About Time* displays two images alternately using a traditional toy: the Jacob's Ladder, driven by clockwork. The elements of this installation convey hints about time and change. The machinery resembles the earliest mechanical clock designs of the fourteenth century. Most of the wood is recycled rimu from a hundred year old demolished building. The Jacob's Ladder is made from matai, a native New Zealand tree that can live for over a thousand years.

The images represent the rocks in context at times separated by 260 million years. You may have to wait five minutes to see both.

# Michael Palin

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Scientist

## *Hot Rock Time Machine*

Thirty-four million years ago, the rocks the students are studying in this photo were on the seafloor. At that time, the young continent of Zealandia was mostly covered by warm Pacific waters even though it was further south. Earth was much warmer then in part because Australia and South America were still tenuously connected to Antarctica, blocking what would become the Antarctic Circumpolar Current. As a consequence, Antarctica was ice-free and sea-level was 100m higher than today.

Geologists know this because the rocks contain evidence of how and where they were formed.

They are a kind of time machine to the past. The dark brown-gray blobs are basalt – solidified lava composed of tiny crystals. If you look carefully, each has a thin black outline. That is a rind composed of glass made when lava contacts water and cools so quickly no crystals can form. Because of their shapes, we call these “pillows” and they are a characteristic feature of lava erupted underwater. The white rock between the pillows is limestone - Oamaru Stone - composed of broken fossil shells. The kinds of organisms and the chemical compositions of their shells reveal that they lived in waters that were twenty degrees or warmer.

These rocks are particularly relevant because they formed the last time Earth’s atmosphere had twice as much carbon dioxide as at present. We are trying to reduce fossil-fuel carbon emissions in order to avoid repeating those levels and their attendant high temperatures and sea-levels.



Boatman's Harbour, Oamaru. Photo: Sophie Briggs, Otago University, Geology

# Jessica Ritchie & Craig Cook

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Artists

## *Standing Still at Boatman's Harbour*

Time scales of human-earth interactions, are so vastly different. Earth is static for such a long time, we get lulled into a sense of it has always been this way. And then there can be changes, either slow changes that are imperceptible (as with climate) or sudden catastrophes that can happen and it takes us by surprise. Geological time is measurable, but also incomprehensible.

Mike Palin invited us to join a geology field trip. One of the locations was Boatman's Harbour at Cape Wanbrow in Oamaru, a site of spectacular "pillow lavas". The volcanic structures were formed in the late Eocene to Early Oligocene. We found ourselves standing in a place that was once 60 metres below the sea surface.



Jessica Ritchie and Craig Cook, *Standing Still at Boatman's Harbour*, 2021, wall rubbing, cyanotype, and painting on paper 1520 X 1040mm.  
Drawing and video created at Boatman's Harbour in Oamaru.

Inspired by the fascinating shapes and patterns in the rock formations at Cape Wanbrow, the drawing was created on site, beginning as a wall rubbing. We then used a cyanotype process, which encompasses the materials of water, sun, and time. The layers in the artwork travels a journey through time, the initial rubbings taken from the physical traces of the lava, formed millions of years ago, to the marks formed by water, sun, and paint.

In the video the push and pull of the waves bring a sense of vertical rather than linear time, the experience becoming almost 'present' orientated. Low level dynamics and extremes of durations encourage a heightened awareness, particularly of small details, which in turn may create a sense of time lengthening and creating a 'space' for the sound of each wave to be itself and the sound of the clattering rocks, is quite unique to this place.

*Scraped from ancient seafloor  
Forged and folded beds of rock  
Upstanding, withstanding  
Worn face of Nature's clock  
J. M. Palin 2016*

# Adam Martin

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Scientist

## *Otago Schist*

The iconic Central Otago landscape of tors (pillars of rock) are made of schist. Schist is a type of rock that was deposited as mud- or sand-sized fragments in the ocean some 250 million years ago. The fragments were buried and heated (metamorphosed) and squashed and stretched (deformed) on the long journey from ocean floor to onshore New Zealand. This history is recorded in the rocks as can be partly seen when looking at them under the microscope (above image). Here, schist rock has been polished to exactly 0.03 mm-thick, which is so thin that light can shine through. Scientists use polarised light which highlights *ribbons*

of the mineral mica as bright pinks, purples and yellows. This is juxtaposed against the grey, blues, blacks and whites of the minerals - feldspar and quartz. This specimen is from the most strongly metamorphosed and deformed areas of the Otago schist, such as can be seen around the Maniototo in Otago. The layering of minerals defines a dominant *fabric*. The fabric records one of the important events that deformed this schist rock as it was lifted from deep in the Earth towards the surface.

The art of weaving beautifully represents the colours, layers and fabrics seen in schist rock from Otago.



Otago Schist rock under the microscope. This image is 4 mm in width. The different colours represent individual minerals. It shows the effect of polarised light passing through minerals of differing composition and structure.

# Christine Keller

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Artist

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*Otago Schist*

Patterns and colours have always inspired me. As a little girl my father sat me down at a microscope and showed me how crystals grow. The polarised light turned colourless preparations into beautiful, colourful patterns. In choosing my scientist I had an affinity to these kinds of patterns from the beginning.

Adam took time to explain the schist to me and was equally curious about the weaving process. He inspired me to use material from Otago in the weaving. Most of the yarn used is super fine merino (from NZ or Australia), spun in Italy, sold to Germany, and returned to NZ; the pink stripes are made from wool from the Paterson Armidale farm near Ranfurly, spun at Bruce Woollen Mills in Milton before they closed. The material for the piece has its own past, as does the rock from the Maniototo. The schist rock was cooked and stretched in geological terms as was the wool I used to weave the piece.

The process of the making has been refreshingly intuitive. I did not make detailed notes but just trusted the process and my experience. Warp threads were dyed and arranged onto 2 beams and 16 shafts on the loom with the given photo in mind. I did not fully control the weave structure as a whole but responded to woven segments on the go. I could never exactly repeat this piece. I really enjoyed making it!



Otago Schist (detail), hand woven, hand dyed, merino from Otago and elsewhere, various other yarns.

# Sophie Briggs

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Scientist

## *Ground Work*



To Earth scientists, the mineral zircon is like a library containing the oldest and most extensive volumes of Earth's history. Zircon crystals form in many different parts of Earth and are physically robust, meaning they can churn through Earth's rock cycle multiple times and survive intact. Each time new zircon crystallises, it preserves a chemical fingerprint of the rock, magma or fluid that it crystallised in, which helps us understand the Earth processes involved in its formation. Zircon also incorporates radioactive isotopes of uranium and thorium into its crystal structure. The radioactive decay of uranium and thorium in zircon occurs at a steady rate over time, allowing zircon to be used as a timekeeper. Coupled with its resistance to physical modification, the chemical properties of zircon make it an ideal tool for unravelling the history of Earth processes.

At MacFarlane Ridge near the Haast Pass, zircon records the injection of sheets of magma into cracks and foliation planes in the surrounding schist rock. The abundance of rare earth elements in zircon's chemical fingerprint reflects the unusual composition of the magma from which it crystallised. This magma is one of the richest sources of rare earth elements (lanthanides) on Earth, providing key components for green technologies such as batteries and wind turbines. Zircon not only tells us when and why the magma was injected into the crust, but its chemical fingerprint also helps us track the complex pathways that rare earth elements take through magmatic systems.

# Katharine Allard

Artist

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## *Ground Work*

The starting point for this project was seeing Sophie's beautiful images of zircon crystals viewed through the petrographic and scanning electron microscopes and learning how zircon has told stories of the earth over billions of years. The next step was wondering how I could do justice to any of it.

It's fascinating to marvel at the secrets of a tiny rock, and difficult to reconcile its significance to earth science with wider use of mineral resources, including making art. I'm interested in the way larger industries influence the development of artist materials. For example, properties that are desirable in commercially produced pigments such as stability, consistency and permanence may limit the potential for more dynamic outcomes.



Making zircon ground.

After experimenting with the high-refractive and abrasive nature of zircon (zirconium silicate), I've developed a sand-coloured drawing ground using commercially available zircon flour (commonly used in manufacturing ceramics).

Over the zircon ground I've drawn an alpine landscape based on Sophie's fieldwork sites on MacFarlane Ridge. The smooth, hard surface is perfect for drawing with silverpoint which will tarnish over time. I hope to draw attention to the art materials from a geological perspective and honour them through my work.

Researching zircon, making observational drawings and meeting with Sophie over the year taught me a huge amount. Additional items on display are linked to the accumulative process of knowledge-gathering: from rock specimens kindly lent from the Geology Department collection, to artefacts from personal investigation into the incredible materials that shape the earth.

# Daphne Lee

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Scientist

## *Cosy Dell: Rocky Shore, Inland Sea*

Cosy Dell seems an odd name for one of New Zealand's most intriguing fossil sites. Near Waimumu in Southland, it pays tribute to the name of the farm whose owners unearthed the fossil treasure trove in a small lime quarry. Since its discovery in 2009, they have made it possible for hundreds of scientists and students to study an amazing Oligocene rocky shore ecosystem far from the present coastline.

At Cosy Dell, some 25 million years ago, subtropical seas lapped up against Jurassic-age basement rocks full of fossil seed ferns. The rocky boulders and the myriads of animals that grew on and around them were preserved by layers of sand and silt and buried beneath swamps that became the Gore Lignite Measures.

Cosy Dell has yielded thousands of invertebrate fossils, many preserved in very hard, calcite-cemented concretions. Molluscs, many with aragonitic shells and colour-patterns preserved, are extremely diverse. They include chitons, 90 bivalves and 250 gastropods. Bivalves include oysters encrusting rocks and thick-shelled scallops. Gastropods include paua and giant turret shells. In addition, there are intertidal and subtidal barnacles, 120 species of microscopic ostracods, brachiopods, echinoids and waterworn reef-corals.



Fossil collectors at Cosy Dell with the digger that first uncovered the fossil treasure trove. Photo: Daphne Lee and Zoe Henderson.

The rich vertebrate fauna of thousands of otoliths (earbones) shows that the shallow warm Chatton seas swarmed with fish, including sharks and rays. Large, middle-sized and small penguins nested on the shores. Drift seeds of a tropical legume, seagrass limpets, mangrove snails, petrified logs and pollen testify to a diverse subtropical coastal rainforest with nearby mangroves and seagrass meadows.

# Vivien Dwyer

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Artist

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## *Cosy Dell*



This piece is derived from the landscape features around the Cosy Dell site as it might have existed several million years ago.

The piece is woven in tapestry form with a variety of threads and embellished with some of the finds I dug myself when on a dig organised by the University of Otago in 2019.

I find it fascinating to know just how different the environment was back then and have tried to represent a warmer and moister place with a seashore that does not exist today.

# Abby Smith

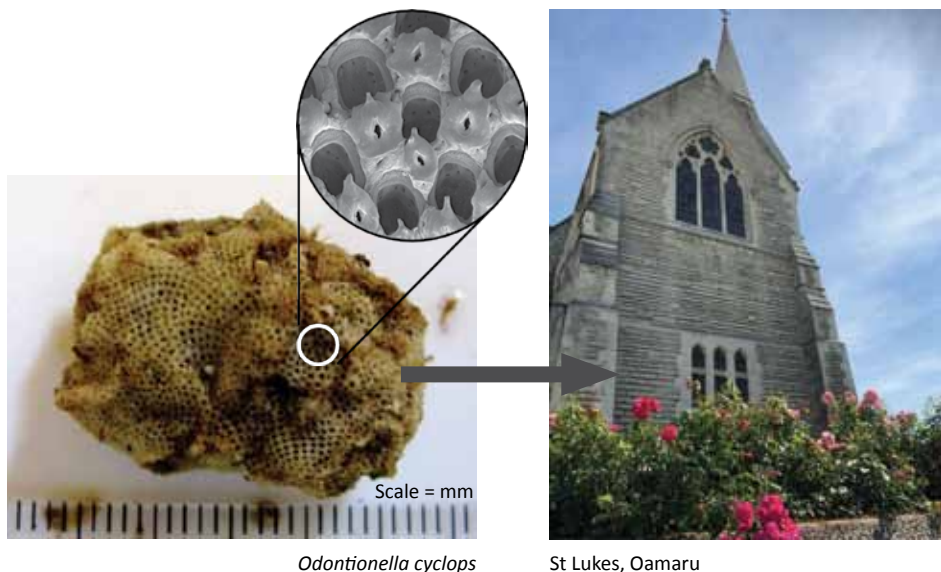
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Scientist

## *Bryozoans: The tiny critters that made enough limestone for a city*

Discovery is one of the great joys of science, and what could be more exciting than digging up a fossil that tells you something about the long-dead past? Fossils are usually bones or shells, but I spend days peering at remnant crumbs of bryozoans that once covered the seafloor. Bryozoans are tiny animals that build their skeletons together in colonies. They make complex structures out of repeated modules, the same way that repeating knitted stitches makes a sock. Look at any stone wall in Oamaru (Whitestone City) and you'll see tiny broken branches and crusts of bryozoans that once thrived in warm shallow water on the Waitaki coastline.

It's amazing to think that animals less than a millimetre across have produced whole quarries of limestone! New Zealand had a diverse and abundant bryozoan fauna 35 million years ago, and it does now too. My research group studies living bryozoans alongside the fossils to discover what they can tell us about the past.



*Odontionella cyclops*

St Luke's, Oamaru

Tiny bryozoans band together to build a robust colony called *Odontionella cyclops*, a glob about the size of a marble, living on the seafloor. When magnified, you can see each contributor is a little box with a big opening for their tentacles to come out and feed, and a protective frontal shield with a spine.

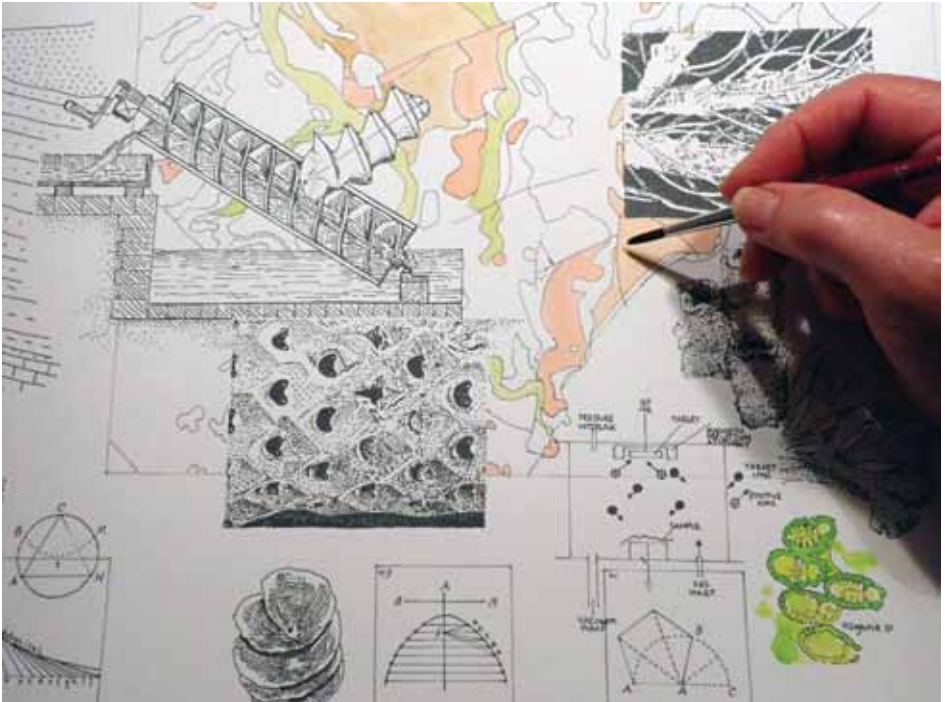
Millions of bryozoans, long dead and broken up, make up the local limestone known as Oamaru Stone, from which this church, and many other buildings, were constructed (it's also the white stone on the Dunedin Railway Station).

# Katherine Steeds

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Artist

*Small Dreams of Grandeur*



Katherine Steeds, *Small Dreams of Grandeur*, 2021, accordion structure book, cotton paper, collage, mixed media.

In this artwork we share our fascination for Bryozoans. Mine has been sparked by the knowledge I have gained in my partnership with Abby Smith. A series of composite and overlapping drawings, complex clonal compositions, incorporates layers of meaning and echoes the compound origins of the soft, creamy blocks of Oamaru stone. I have drawn on my thoughts of the paradoxical nature of inhabited human-scale spaces created from stone which is the fossil remains of tiny structures created and inhabited by minute marine animals. Dust to dust, life to fossil, fossil to stone.

A slip-cased accordion book format allows the viewers to choose where to enter the story, and to influence their personal experience of participation with this artwork by an unfolding non-sequential disclosure, visually picking their way through a variety of bryozoan forms, many with intriguing appearances suggestive of more familiar objects.

The aim is to expand a common view of the Earth materials we sometimes fashion into buildings and decorative structures.

# Bryce Peebles

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Scientist

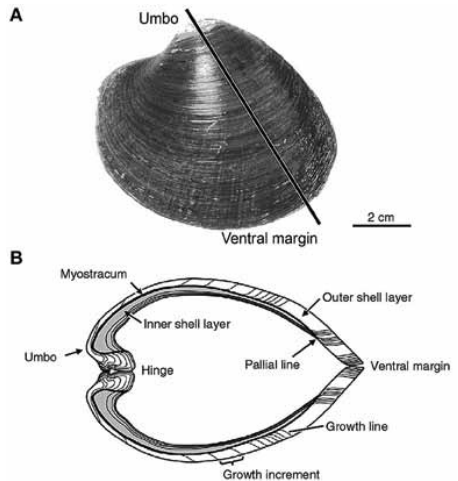
## *Marine biomineralisers*

Organisms that make hard parts of their body (like bones, teeth, scales, and shells) are called biomineralisers. Marine biomineralisers make their shells by taking chemical components directly out of the water. These chemical components are usually carbonate (a combination of carbon and oxygen) and calcium ions; however some animals have even evolved to use iron to form metal teeth, scales, and shells.

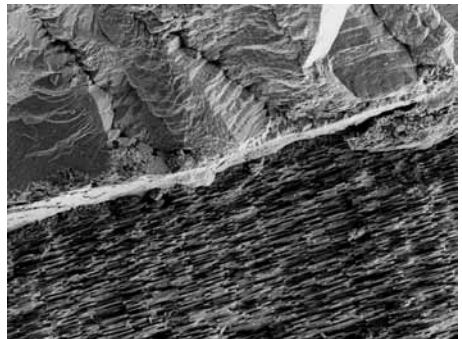
Typically, the absorbed calcium and carbonate ions are used to form one of several types of calcium carbonate. For example, pāua form two kinds of calcium carbonate – aragonite and calcite. The outer (dorsal) layer is calcite and is the duller, browner colour. The inner (ventral) layer that has the characteristic blues and greens the shell is famous for is made of aragonite. Part of my research investigates how biomineralised structures, like pāua shells, break down over time and make it into the fossil record.

They are incredibly interesting and useful since we can use them to learn what the oceans were like in the past. The ions that are used by biomineralisers to form shells keep the same isotope ratio as the water they were taken from.

Several qualities of the water are reflected in its isotope ratio, for instance we can use the oxygen isotope ratio to determine the temperature of the water. Since the shells keep the same isotope ratio, we can learn about the oceans of the past through the “record-keeping” of shells.



Cross section of Shell.  
Diagram adapted from BR Schöne (2003).



Youngest Cross section 1500x.

# Kate Elder

Artist

25

*Biominaliser of the Year*



Caption Kate Elder, *Biominaliser of the Year*, 2021 (detail).

Marine biomineralisers typically have shells made of calcium carbonate, but with marine environments undergoing unprecedented change due to pollution and climate change, could they evolve to make use of other chemical components in the water?

Here I have created a cross-section of an imagined biomineraliser of the future - able to take anything out of the immediate environment to create its shell.

Starting this project at the beginning of 2020, I soon found myself trying to create a work in lockdown. With these limitations in place, I started creating my shell - much as a biomineraliser would - from material in my immediate environment.

So, with plastics, cardboard, papers and various off cuts from artworks and projects completed during this time I produced a monster shell, and in doing so, created a record of the year that was March 2020-2021.

# Mathew Vanner

26

Scientist

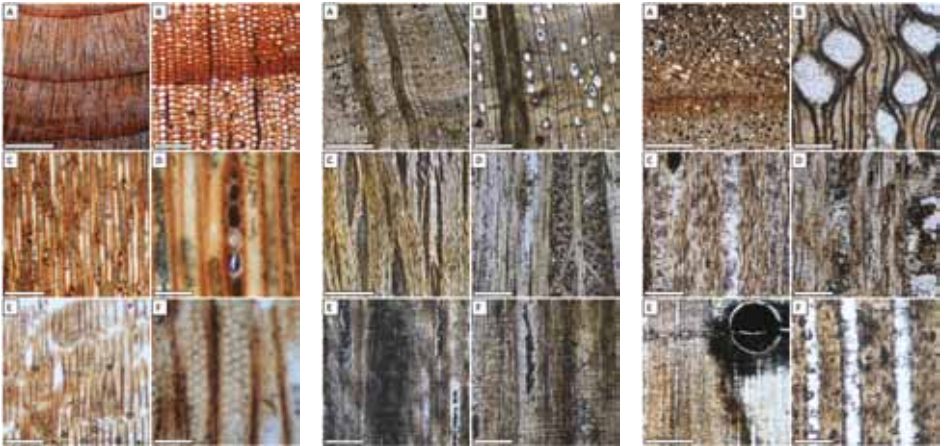
## *Fossil wood*

Ancient forests covered much of New Zealand's landscape. These persisted from the time of Gondwana into the modern era. On occasion, the trees forming these forests became covered by ash fall or an anoxic bog, the first step of fossilisation. Exposure to ground water with high amounts of dissolved silica, calcite and other minerals is the second. This fluid flows over the dead trunks, replacing the organic tissue with these dissolved minerals, turning them to stone.

Eventually, after millions of years, they may be brought back to the surface.

Once at the surface, it is possible to study these ancient stone trees, to discover which modern family or genera the fossil trees were most closely related to. This is done by taking sections at different orientations – transverse, tangential and radial– which give three different views of the fossil cellular structure. These sections are carefully ground until they are less than a hair width across. The structures revealed are compared to those of modern trees.

In the South Island, there are many sites that yield fossil wood of different ages. It is possible to find a nearly complete record of wood from the Jurassic (200 mya) to the Quaternary (almost modern). *Araucarioxylon*, ancient Kauri, has been present in New Zealand for the entirety of that record. *Nothofagoxylon*, precursor of Southern Beech, has fossilised wood of Miocene age and is still present today. *Casuarioxylon* and *Eucalyptus*-like wood are also present in the Miocene but die out before the end of the Pliocene.



Slides from left to right: Kauri, Casuarinaceae, Myrtaceae.

# Pam McKinlay

Artist

27

## *Petrified Sampler - forest timelines caught in stone*

Petrified wood is rock and like other ancient fossils reveal something particular to the individual trees from the time and conditions when they were living. Somewhat miraculously the textures and patterns are captured in the fossilised wood and can be seen millennia later in the remains.

In a free-weaving response to the petrified wood samples from Mathew Vanner's research I designed a weaving sampler using a series of experimental lifts, weft manipulation and tapestry techniques to interpret his microscope slides. The title reflects both his scientific methodology of preparing fine slivers of petrified rock samples for microscopic examination and the weaving of short experimental blocks to depict the visual material in the slides.

Across the different species the cumulative fragments reveal morphological similarities and distinctive characteristics at the cellular level. Reading from top to bottom the Araucariaceae, Casurinaceae and Myrtaceae families traverse the Jurassic to Quaternary periods in a linear paleobotanical timeline.



Pam McKinlay, *Petrified Sampler: forest timelines caught in stone*, wool tapestry, hand woven on a 12 shaft table loom with a double warp beam, fired clay forms *Araucaria Araucana*, (work in progress).

As we view the stops and starts we might also reflect on the continuity of the Araucariaceae lineage and ponder its future and conservation status in the new century: with Kauri die-back (New Zealand), the constant double threat of extinction and wildfire for the remaining stand of Wollemi pine (Australia) and life on the endangered list and CITES Appendix for monkey puzzle trees (Chile, Argentina).

# Grace Duke

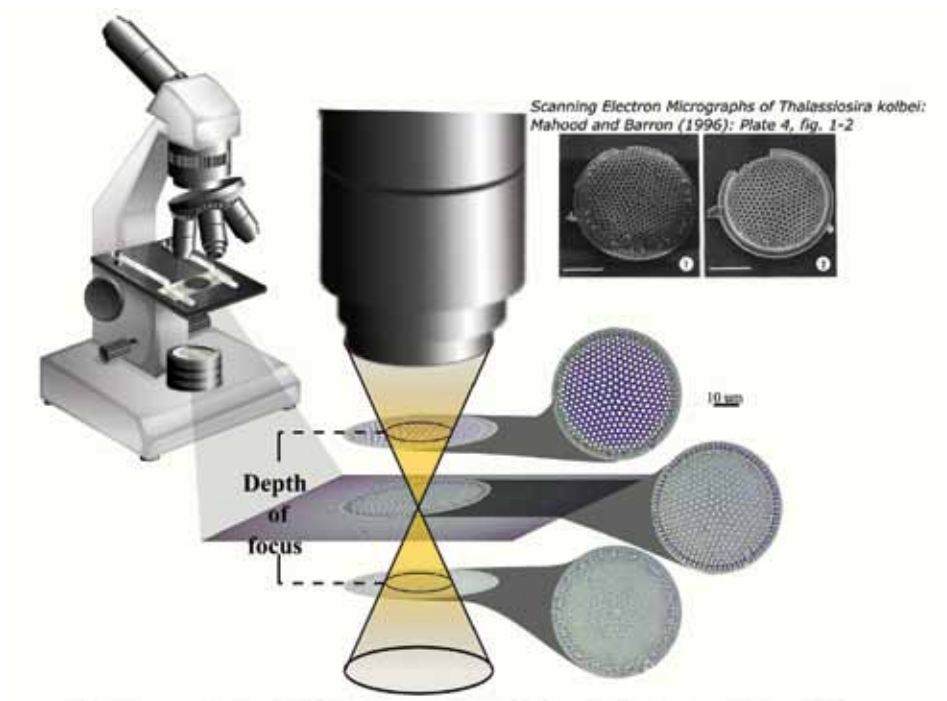
28

Scientist

## *Diatoms*

Diatoms are photosynthesizing micro-organisms that live in the Southern Ocean. When they die, they settle to the ocean floor and over time, get buried by more material settling out of the water column. We can learn about past environmental changes by collecting a core of sediment from the ocean floor and counting the different diatom species at different depths. Diatoms come in all shapes and sizes, its diversity reflecting the variety of environments they can thrive in. However, diatoms cannot be seen with the naked eye. Diatomists, scientists who study diatoms, use microscopes to magnify ocean sediments spread over a glass slide and affixed using an epoxy. The microscope reveals the elegant, complex silica-based skeleton of a diatom, and by changing the focus on the microscope, different details on the diatom surface pop out.

The bumps on the knitted hat represent pores on the diatom valve face that appear clear and distinct at a certain depth of focus, the dark fuzzy yarn represents the loss of clarity of the space in between.



# Stella Lange

Artist

29

## *Shadows Unfocused*

Grace Duke spoke of her work examining diatom fragments and how each discovery was a moment of clarity, providing clues as to the conditions and aspect in which the original organism lived and thrived.

Diatoms leave fragments of their past lives in water and soil. Their tiny remains are made of glass - transparent opaline silicate. Each kind of diatom is a sophisticated kaleidoscope of symmetric patterns. Finding, identifying and interpreting what these fragments can tell us requires the use of a microscope. Under magnification fragile and complex structures are revealed and clarified – but the shallow depth of focus required makes the process of looking for each fragment a hunt, a search, and then an intake of breath as the structure pulls into focus and becomes clear.

This hat replicates the sensation of focussed and unfocussed discovery, and is knitted in a super soft cashmere and lambswool. Repeating bumps, swirl around the hat with each bump created by a simple technique of dropping down a column of stitches and then knitting the freed stitches as if they were one. The valleys between each bump are intensified with a darker strand of fine mohair and silk yarn – mimicing the blurring and out of focus sensation that occurs as a microscope lens travels in and out of its depth of field.

This pattern is seamless, knit in the round, suitable for those new to knitting but comfortable knitting purling, and counting to six. The pattern is available free on Ravelry.com, look for “Shadows Unfocused” by Stella Lange.



# Marcus Richards

30

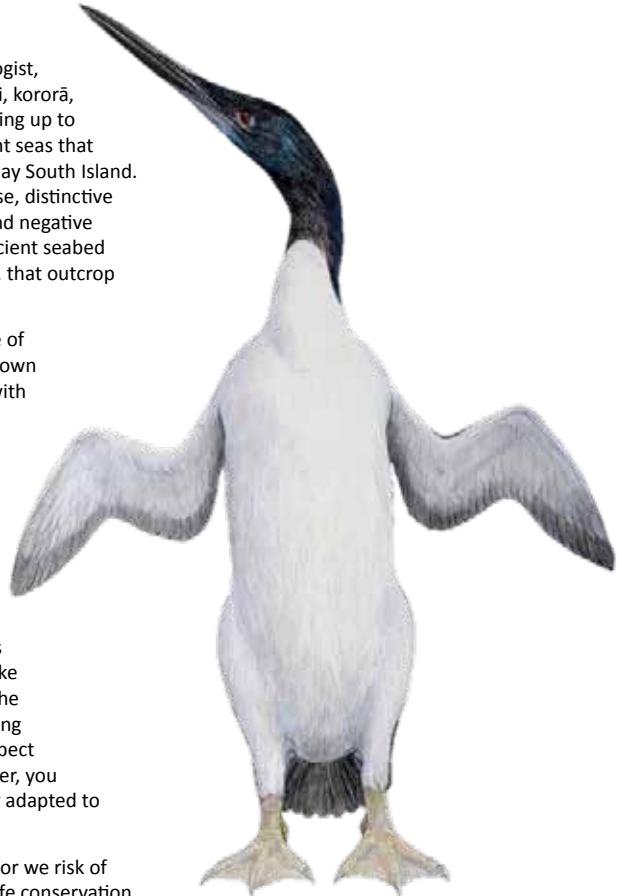
Scientist

## *Penguin evolution*

Penguins have shared a long-standing connection to Zealandia's shores and waters. As a palaeontologist, I can trace the whakapapa of tawaki, kororā, and hoiho back to giant birds towering up to human height that swam the ancient seas that once covered parts of the present-day South Island. The evidence for this lineage is dense, distinctive bones well-shaped for swimming and negative buoyancy are found littering the ancient seabed deposits, up to 60 million-years-old, that outcrop throughout the countryside.

Penguins are an exemplary example of evolutionary adaptation. Earliest known species, like the *Waimanu* figured with my text here, show a transitional morphology between their air-flying ancestors and the stocky aqua-flying penguins we know today. *Waimanu* has larger, webbed feet and foldable wings that worked together to help it swim like a cormorant underwater; vestiges of its inheritance from its flighted seabird ancestors. Penguins have since evolved a strong blade-like rigid wing to propel them through the water and their feet are small, helping with steering. When you closely inspect penguins, a bird that flies underwater, you develop a sense of awe at how they adapted to their unique and bizarre lifestyle.

We must preserve what care about or we risk of losing it - a cold, hard truth of wildlife conservation. Penguins are extremely vulnerable to how we treat the world around us: we overexploit fish stocks, human-induced global warming is shifting ocean fronts and associated food sources due to warming waters. Also, we and our pets predate and harass penguins whilst they roost and breed on land. If we can appreciate that penguins have been



*Waimanu* - Copyright of Geology Museum, University of Otago - artwork by Chris Gaskin.

here in Aotearoa for a nearly unfathomable length of time (>60,000,000 years!), then we should be empowered to make moves to halt our wanton neglect we show them. They deserve our Respect.

# Manu Berry

Artist

31

## *Penguins Diving in Deep Time*

I have said, but never really believed, that looking upon a mountain makes me feel insignificant. Actually, looking on these massive structures, I feel expanded, as if this vastness has come to live inside me. I have experienced the same thing during this project while learning more about the expanse of deep time and the wondrous complexity of evolution.

With his deep understanding of this subject (and his creative use of everyday props!), Marcus Richards has been able to impart the sense that these vast stretches are very real and embedded in our lives, not just a theory in a textbook. Using a blanket wrapped around his crouching form, for example, he was able to explain how a penguin's thigh bones and hips are encompassed within its form, enabling it's surprisingly powerful hop, and opening a door for me to see the connections between all vertebrates.

In learning about the gradual laying down of Bryozoans upon the submerged continent of Zealandia with their entombing of ancient penguin skeletons and creation of limestone, I have come to see geology as a player in the story of life and not just a static background. This has helped me break from my simplistic view of evolution as a steady climb upward on a ladder of progress and let me into the possibilities of it being an ever-changing response to an environment of fluid and unexpected qualities.

These works have tended towards playful games and puzzles to express that we are working with parts to configure or extrapolate a whole but always with an awareness that any "truth" we rest upon may shift over time.



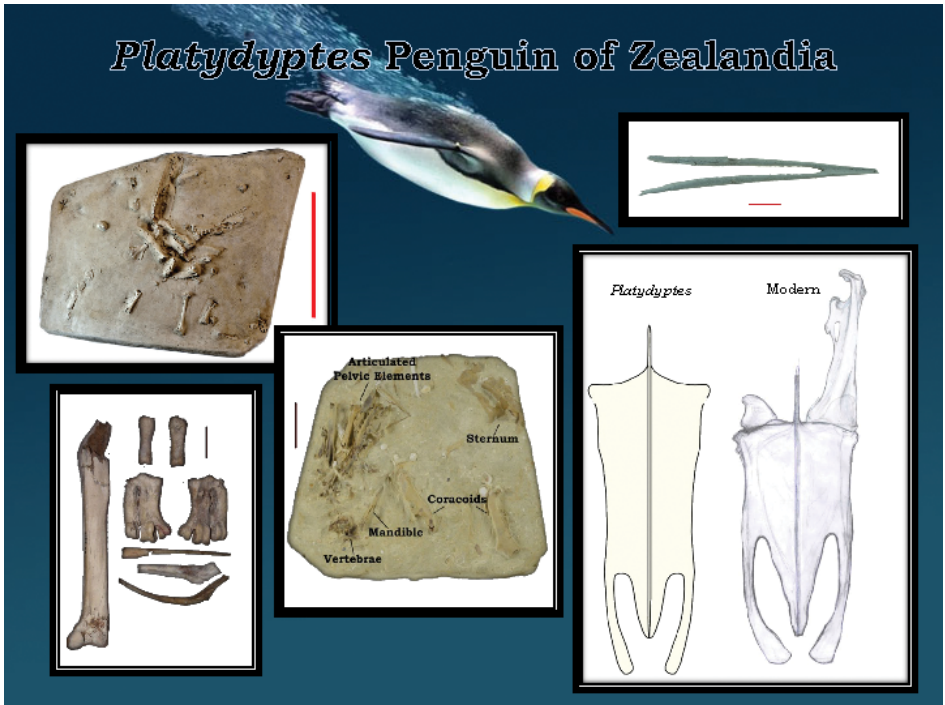
Manu Berry, *Penguins Diving in Deep Time*, woodcut, 1010 x 1400mm.

# Katie Matts

32

Scientist

## *Platydyptes* Penguin of Zealandia



The dense bones of penguins incline them towards fossilisation; as such there is an excellent record of fossil penguins in New Zealand. Of these *Platydyptes* (*Platy* = broad, *dyptes* = diver) is one of the few described genera of the Late Oligocene. This genera has an interesting placement within penguin evolution, it is one of the most crownward (modern) of the stem (ancient) penguins with its position within penguin history showing *Platydyptes* as a precursor for the crown radiation of penguins. In other terms *Platydyptes* contains an interesting mix of both ancient and more modern features. There are several well preserved examples of *Platydyptes* at Otago University.

Otago University's Geology Department hosts its own museum open to public during weekdays, here there is a working prep lab that can be seen into.

# Desi Liversage

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33

Artist

*Unearthing*

*Platydyptes* is an extinct genus of giant penguins found largely in the Hakataramea Valley, North Otago. While interviewing Katie Matts about her work I became fascinated with the exhaustive process to unearthing the *Platydyptes* fossils and the story they tell.

The industrial looking, luminous orange overalls the scientists wear, belie the intricate task of careful excavation and discovery.

I use my delicate, intricate stitches as well as a grid structure to mimic the grid used at the site to unearthing the traces of these magnificent birds of the sea.



Embroidery, 800 x 500mm.

# Emma Curtin & Henrik Moller

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34

Scientists

## *Dung beetles to the rescue!*

Soil is not just dirt! It's a living ecosystem that holds nutrients and water, stores carbon and grows plants upon which all animals depend. Soils are also the world's composting system - a thriving community of bacteria, fungi, and invertebrates drives a vast, spread-out, recycling system to break down dead plants and animals into nutrients which can be reused by the next generation of plants and animals.

This army of decomposers have some special allies which ecologists call 'ecosystem engineers' – the earthworms and dung beetles. They build and maintain the soil habitat itself and thereby enable all those other critters to do their great life work. Earthworms and dung beetles gently till the soil to spread the nutrients. They disperse organic matter that glues the soil particles together and create tunnels and pores which let the air and water into the soil.

Converting much of New Zealand to farmland created a smelly problem - how to disperse and breakdown all that cow and sheep poo! So far eight species of dung beetle and 23 species of earthworm have been introduced to help. Some dung beetles are "tunnellers" that act like miniature bulldozers: they that shove dung down tunnels that they have dug directly under the dung pat. Others are "rollers": they shape the dung into neat balls and roll them away from the pat to bury them. And there are "dwellers": they live entirely within the dung pat. All feed on and lay their eggs on the dung.

Dung beetles provide "ecosystem services": they make and maintain soils, improve water penetration and storage, reduce run-off of nutrients and sediment to streams, improve carbon capture, disrupt the transmission of parasites and improve the productivity of pastures for us to grow food and fibre. Dung beetles are our unsung friends.



# Meg Brasell-Jones

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35

Artist

*Connectivity/Reciprocity*

Dung beetles connect history, myth, science, and economy. They symbolise regeneration and restoration of life. They keep vital ecological cycles churning, build soil, disperse nutrients, and play a role in protecting our streams. They improve soils to help feed people.

*Te toto o te tangata he kai,  
te oranga o te tangata,  
he whenua, he oneone*

While food provides  
the blood in our veins,  
our health is drawn  
from the land and soils.

This concept, offered by te ao Māori, advocates for a strategic reciprocity between humans and those elements and organisms with which we coexist. We depend on each other in myriad, often microscopic, sometimes macroscopic ways that are woven and entrenched in each other's wellbeing. This connectivity is explored by scientists, Emma Curtin and Henrik Moller and in this work, albeit in varying ways. Our energies and interests reveal a shared love and kaitiakitanga of our astounding biosphere, but also a concerted effort to work towards regeneration and restoration. This first acknowledges past and present missteps, but then embraces an optimistic vision of future synergies.



Meg Brasell-Jones, *Connectivity/Reciprocity*, 2020 acrylic on ply 700 x 700mm.

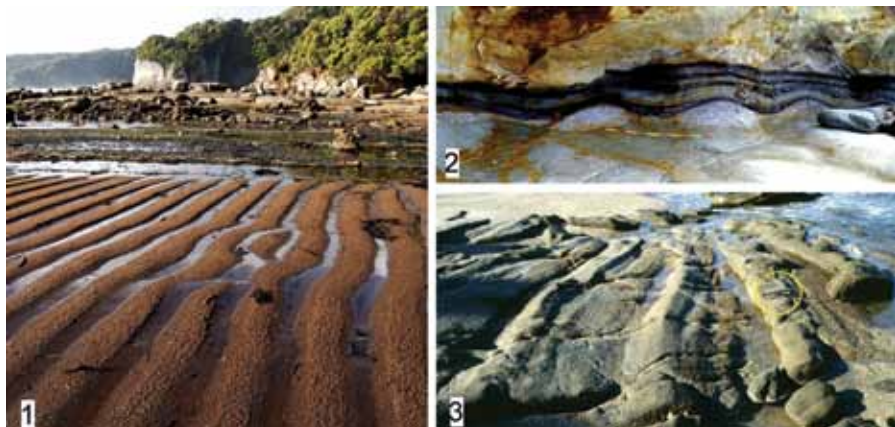
# Jon Linqvist

36

Scientist

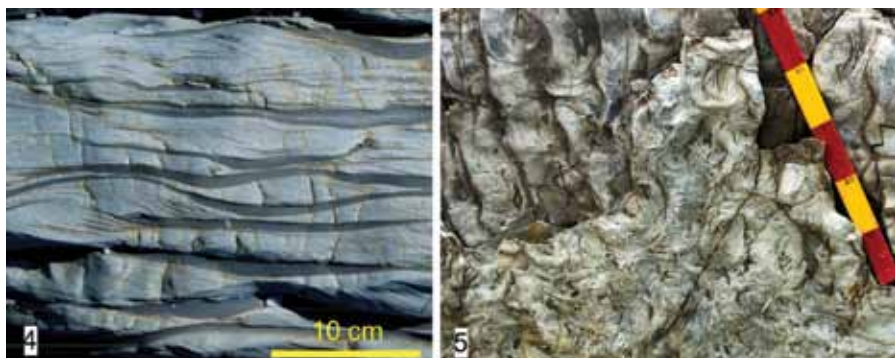
## *Current Ripples – Modern & Ancient*

Ripple structures in sedimentary rocks help determine the environment where a rock formation was deposited, whether prehistoric dune field, river, lake, tidal estuary, sand beach, coastal shelf, or deep ocean basin. They are formed during the entrainment and settling of sand grains in flowing water or air. Modern examples are fascinating to many taking a beach walk. Ancient ripples aid in tracking the positions of shorelines that shifted through geological time.



1: Modern beach ripples in coarse sand near Puysegur Point, Fiordland.

2, 3: Ancient fine gravel ripples, Wangaloa Formation (Paleocene age, ~60 million years), Great South Basin, South Otago.



Whakapohai Formation (Cretaceous age, ~70 million years), South Westland Basin.

4: In vertical profile, ripple foresets in fine sand reveal tidal flood and ebb flows. Dark mud was deposited during slack water.

5: Plan view of straight-crested and tongue like (linguoid) ripples. Water flow was to the left.

# Heramaahina Eketone

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37

Artist

*Ripo moana - The effects of wind and water on sand*

Ripo or ripo moana - are the whirl pools and eddies including current flow that form ripples in sand. The imagery of ripo moana stands above and shows what happens underneath the surface.

While the sound-waves of the Pūtōrino cannot be normally seen, the ripples left by the water are a visual illustration.

Pūtōrino are typically made of wood. Here, uku (clay) has been used to acknowledge Papatūānuku the earth mother - that we reside in her space and while we are a mere blink in time, what we do, does matter.

Haehae - have been used to create the cuts needed to form and present as ripples left by the water.

Aronui - acknowledging that the reason that we know things/ anything is through careful observation. Through focus and study we gain knowledge and understanding.



Pūtōrino, work in progress, unfired uku.



Glaze trials, fired uku.

# Sophie Horton

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38

Scientist

## *Kaikōura wave energy*



The ocean waves and their interaction with coastlines have fascinated scientists for centuries: as the frontier between the inexorable advance of the ocean abutting against the stalwart land margin. How and when a cliff face or rocky shoreline will be breached, and under what conditions this happens is a key area of coastal science research. Rocky shorelines that are intertidal are of particular interest, where the shore is inundated for a few hours each tide, and then exposed again. These shore platform environments protect some of the most precious land. Often ancient urupa and middens are hidden within the nearshore zone and if the wave energy is sufficient and frequent, waves will erode the material and expose taonga. As a scientist I am researching wave energy in shore platforms, and how this is dispersed and expended at the coast.

On coastlines such as Kaikōura and Māhia in New Zealand, it is the infragravity waves, those that form across the ocean far away, that are responsible for erosion of the wide platforms that surround both peninsulas. We measure these waves with recording devices that determine the frequency that the wave forms occur. The wave record you can listen to here is from Kaikōura in 2019, and the change in intensity is because of an incoming southerly. In these conditions, the quiet, rolling lulls of infragravity breaths are disrupted with the discordant roars of the swell that picks up energy as the low pressure air system moves northwards.

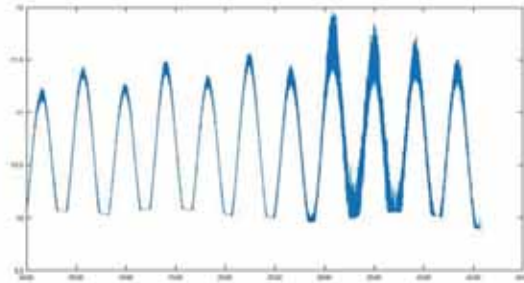
# Eden Smith

39

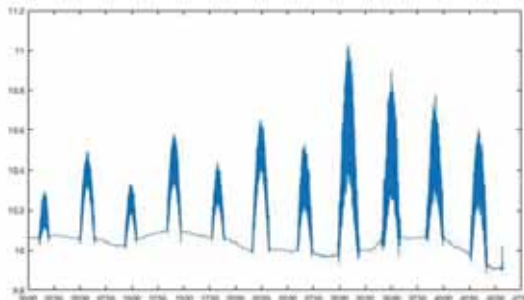
Artist

*(Soundscape)*

The starting point for my piece was a series of charts that Sophie provided me of her work. These charts showed the tidal cycles and wave intensity of an area in the Kaikoura Peninsula that had been affected by the recent earthquakes. What struck me about the charts was their rhythmic regularity across the x axis and their 'randomness' (for want of a better word) along the y axis (that is, the peak of each cycle has a slightly different height)



My soundscape is an 'interpretation' of Sophie's data. To mirror the regularity of the x axis, the tempo is a constant 60 beats per minute. The 'dips' in the chart are conveyed by a cyclic foundation 'low' sound that is 8 bars long and repeats constantly. The 'peaks' of the chart are represented with another 8 bar long sound (that has a slightly higher note) that occurs every 16 bars (i.e. 8 bars on, 8 bars rest) and creates a crescendo. To convey the varying intensities of the 'peaks' (which in the graphs are shown by some peaks being 'heavier' than others), four higher sound waves (also 8 bars long) come and go at different intervals. Some play every 32 bars (i.e. 8 bars on, 24 bars rest), some every 64 bars (i.e. 8 bars on, 56 bars rest) and so on. Because of the different time cycles, different combinations of sounds happen every 16 bars, with it returning to the 'base sound' (the 'dips') every eight bars. Depending on how the parameters of this soundscape are set up, you could have something which never repeats in quite the same way during the course of a day.



# Sharon Hornblow

40

Scientist

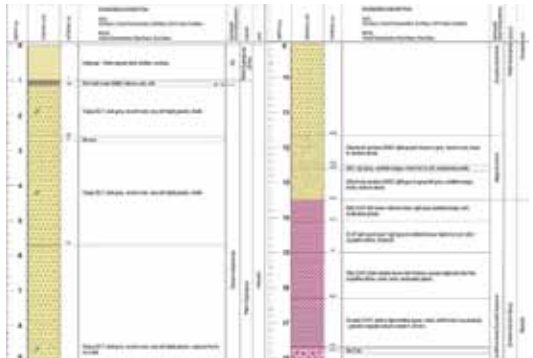
## *The ground beneath Dunedin*

Naturally occurring physical processes and human activities have created and modified the South Dunedin and harbourside area of Dunedin CBD over time. Public recreation areas such as St Clair beach and sand dunes are heavily modified from their original, native form through engineering and introduced plant species. Many of Dunedin's public assets are situated on a low-lying reclaimed coastal plain, in places seaward of the mapped 1800s shoreline. Parts of South Dunedin are lower lying than those reclaimed from the harbour as they were only filled to a level just above the water table at the time, using compressible fill material from the nearby dunes. Future adaptation plans will need to first recognise South Dunedin's geological setting and address the resulting natural hazards, their interactions, and cascading effects.

Researchers and Otago Regional Council scientists are using drilling to investigate geological properties of the ground beneath Dunedin. Core recovered from South Dunedin has been analysed and conclusions drawn about past environments that existed when the material was deposited, over thousands of years. The shallow core samples show sand, shells, and estuarine sediments with occasional anthropogenic objects. Deeper down, silty estuarine and marine sediments indicate when the area was drowned by water after the last ice age. The oldest core samples come from volcanic and sedimentary basement rocks which would have been part of a hilly landscape, cut through by now-drowned waterways, when sea level was up to 120 m lower, and the coastline many kilometres away from present day Dunedin.



South Dunedin Drill Map, Natural Hazards Analyst, Otago Regional Council.



South Dunedin Core Log.

# Becky Cameron

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41

Artist

*core values*



This work suggests that the future course for South Dunedin may lie in the intersection of its environmental and human histories.

The vertical column of prints echoes the core samples that Sharon Hornblow uses to study the geological and environmental history of the South Dunedin area. They are based on locally found natural materials, referencing the changes from wooded river valleys, flax swamps, to ocean that the area has undergone in response to changing climate and sea levels. The European habitation of South Dunedin has attempted to prevent these continuous fluctuations by draining and infilling the swamps, and trying to fix the dunes in place with marram grass and lupins.

This environmental element is overlapped by a representation of South Dunedin today with people from the present and from history. Gathering of food resources by Māori was replaced by Chinese vegetable gardens and European orchards, which gave way to more housing and industrialization. In 1889 NZ's first trade union, the Dunedin Tailoresses' Union, was founded, and South Dunedin people also played a key role in the campaign for votes for women. Much of the industry is now gone, and the area struggles for employment and resources; but there are still strong community groups working to improve the lives of their diverse people.

By drawing on knowledge of the environmental and social histories of the area, and the resilience of the present day communities, perhaps flexible responses to current environmental challenges of sea level rise and flooding can be developed.

Becky Cameron, *core values*, monprint and drawing on paper, approx 800 wide x 3000 tall.

# Christian Ohneiser

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42

Scientist

## *How close are we to a runaway Antarctic ice sheet retreat?*

The poles are warming more quickly than the rest of the planet; a feature known as polar amplification and the evidence is clear now that our addiction to fossil fuels is responsible. While much attention has focused on the impacts of climate change, on weather systems and surface temperatures, only recently have we taken seriously the threat of sea-level rise caused by Antarctic ice sheet retreat. For decades arguments raged in the scientific community between those who said Antarctica and its ice sheets were too big and too cold to be affected on human timescales by climate change, and those who thought otherwise. It was the latter group of glaciologists and geologists who suggested that, even though Antarctica's ice sheets seem vast and unchanging, they are also sensitive to slight temperature changes which can destabilise them and lead to runaway retreat. Now a new argument has emerged. How hard have we pushed the ice sheets and how close are we to a runaway ice sheet retreat? Scientists from Otago University, and other institutes in New Zealand and around the world are probing Antarctic's ice sheets and shelves, its geological records and installing instruments in the ocean and on the continent so we can monitor for signs of change and understand better where (and when) the tipping points are.



Geologists walking towards their campsite in Walcott bay Antarctica.

# Fiona Clements

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43

Artist

## *Antarctic Terror: A screaming symphony of icebergs*

My climate anxiety feels enormous compared to the icebergs rafting off Antarctica and I don't believe our government is taking our declaration of a Climate Emergency seriously or acting fast enough. It's why I chose to create this work. Greta is right "30 years of blah, blah, blah" isn't good enough, where's the real REgenerative on the ground support and action?

I am speaking directly to the urgency of 'He Pou a Rangī'! And how far it doesn't go in addressing our responsibilities as a global and community player.

The urgency to act feels imminent,  
the policy to do so feels inadequate.

The anger and frustration grows daily  
We watch, we speak out  
We give our time to causes  
That create frailty  
Within our hearts and our whenua

As we continue to wait for action from above  
These grassroots grow tenderly  
To enact revolution!

The expression of self assists us in transmuting  
climate anxiety, facing an uncertain future,  
trusting the current governance bodies to take this  
seriously.

Fiona Clements | *Senorita AweSUMO*



*Antarctica's presence reassures us in the Deep South, Zerowaste Diamond Back T* constructed from Silk, organic cotton thread, Permaset Aqua ink & water.

# Sophie Horton

44

Scientist

## *River rocks tell a story*



River rocks tell a story. The story of how our mountains wear away, how easily the land breaks down, and how efficiently that material is moved from peaks to the sea. Mountain rivers are a jerky conveyor, moving pebbles, gravel and boulders in pulses in response to storm events.

The movement of rocks in rivers is a complex, irregular process governed by hydraulic processes of lift and drag forces that roll and bounce rocks through the river network. Material in rivers comes from slope failures high up in the catchment, loosened by intense storms or seismic shaking. The Southern Alps of Aotearoa New Zealand have some of the highest erosion rates observed anywhere in the world and sediment material is abundant and is continually being generated from the steep mountain slopes. It stays in place until the river network is able to move it, pulsing it down the network.

Scientists are interested in the journey of this material: it tells us about how quickly our landscape is changing; it provides essential habitats for endangered endemic birds; and nourishes our coasts either as shingle beaches, or as sand. Sand and shingle are products of attrition, and as the

rocks jump and roll they smash together becoming ever-smaller downstream. Understanding how rocks move in rivers has fascinated scientists for generations, and one of the earliest techniques for understanding rock movement in rivers, was to brightly paint rocks and see how far they travel. Paint a rock; let's see where they end up.



# Debbie Fleming

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45

Artist

*Travelling stones talk*



*Travelling stones talk*  
*Endlessly*  
*About the weather*  
Debbie Fleming

I have collaborated with geomorphologist Sophie Horton to create a fun interactive experience for adults and children with the upshot of participation and conversation surrounding process and residence within their landscape.

Rocks were collected from a variety of sites in the Waitaki area. Crayons and pastels are made available for participants' creative expression. We encourage viewers to immerse themselves into the artwork stimulated by the above Haiku and the stones. On the floor flows a river of stones for participants to add their own characters. The viewers are urged to create a self-portrait on a rock of their choice, supporting their own personal vicarious presence, as guardians of knowledge and the landscape we call Aotearoa. Depicting chattering characters, the journey from the mountains to the sea will be shared.

Each piece when completed is included in the growing river, inspiring awareness of the collaborative journey, sharing learning and demonstrating cognitive value of the experience and new-found understanding. As the stones are eventually returned to water, they will continue their journey across the land to the sea, essentially chattering about the weather, droughts and floods.

# Faye Nelson

46

Scientist

## *Nature and timing of Earth and ocean processes through magnetic minerals*

Earth is surrounded by a geodynamo-generated magnetic field, with the angle, polarity and flux density of the field lines loosely dependent on latitude. At times the magnetic poles weaken and eventually settle in the opposite polar region. The last time this happened was 780,000 years ago. These reversals are represented as the black and white stripes of the Magnetic Polarity Time Scale.

We know reversals have happened because magnetic minerals—such as magnetite—lock-in a record of Earth's past magnetic field. For volcanic and metamorphic rocks, the lock-in happens as the minerals cool below a certain temperature. In sediments, the magnetite minerals are like little compasses that rotate to align with the Earth's field as they settle.



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Otago Paleomagnetic Research Facility's Superconducting Rock Magnetometer is sensitive enough to measure the strength and angle of magnetisation in long mud cores, which form a nearly continuous record of the Earth's magnetic field. We also apply magnetic fields and measure the response to determine changes in magnetic mineralogy, grain-size and concentration that can be used as a proxy for environmental change.

I study sediment cores from offshore New Zealand that record continuous climate cycles back as far as 2.5 million years ago. These records are significant because the relentless uplift and erosion in the Southern Alps has erased so many terrestrial deposits. We can then compare the timing of Southern Hemisphere events to the timing of events in the Northern Hemisphere and learn more about global climate connections.

# Vivien Dwyer

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Artist

47

*Floor spreading in the ocean.*



This piece is special to me as plate tectonics was one of the things I found absolutely fascinating about geology. The idea that one can find almost mirror images on either side of the mid oceanic mountains lead me to replicate the process in textile form but keeping the regular irregularities of the natural process as well. Because this is a hot process, I have used warmer colours in the centre and have used a horizontal surface to display it on as the process itself is on the surface of the earth in the crust that floats above the mantle.

# Faye Nelson

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Artist

*Nature and timing of Earth and ocean processes through magnetic minerals*



The field notebook is a ubiquitous piece of field kit for geologists. During my visit to Viv's studio, I was fascinated by her stratigraphic tapestries and inspired by her fabric book projects. Viv's piece for this project takes us into the deep ocean where seafloor spreading at a mid-ocean ridge forms magnetic polarity stripes. These magnetic anomalies (mapped by a magnetometer towed behind a ship), deep-sea core magnetostratigraphy and paleomagnetic evidence of drifting continents contributed to the acceptance of plate tectonics in the 1960s.

With this textile field notebook, I am tracing my journey across the Pacific from land-based paleomagnetism in North America to marine paleo- and environmental magnetism on Te Riu-a-Māui/Zealandia. Using fibres and a vintage Singer sewing machine to recreate field notes, sketches and big-picture concepts in paleomagnetism has led me to contemplate my journey from a different angle.

# Alan Cox

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Guest Artist

49

*Three birds*



Photograph: Alan Cox

The gold sluicings at Blue lake, St. Bathans, under late evening light with pigeons, that roost in the area.

670mm x 530mm (framed)

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# acknowledgements

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We would like to thank all those who have helped to make this Art+Science Project and Exhibition possible: the Dunedin School of Art and Otago Polytechnic, the Geology Department at the University of Otago and GNS Science. Special thanks to Joanna Wernham for designing and help with exhibition furniture.

Pam McKinlay, Jenny Rock, Bryce Peebles.  
Project Co-ordinators.



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Front cover image: Manu Berry.

art + earth exhibition 2022