https://doi.org/10.34074/scop.1022029

WOOL WEAVES AND ROCK FABRICS: AN ART+SCIENCE PROJECT PARTNERSHIP BETWEEN WEAVING AND GEOLOGY

Scientist: Adam P Martin
Artist: Christine Keller

THE MAKING OF 'OTAGO SCHIST'

Common terminology in geology: fabric, texture, structure, ribbon, parameter, folding, stretching

Common terminology in weaving: fabric, texture, structure, ribbon, parameter, folding, stretching

The iconic Central Otago landscape of tors (pillars of rock; Figure 1) are made of schist.[1] Schist is a type of rock that was deposited as mud- or sand-sized fragments in the ocean some 250 million years ago.[2] The fragments were buried and heated (metamorphosed) and squashed and stretched (deformed) on the long journey from ocean floor to onshore New Zealand.[3] This history is recorded in the rocks, as can be partly seen when looking at them under the microscope (Figure 2).

Figure 1. A photograph of the Otago Schist, taken near in the Maniototo, Central Otago, New Zealand. The tors in the foreground are 3-4 metres tall and the Rock and Pillar Range can be seen in the far distance.

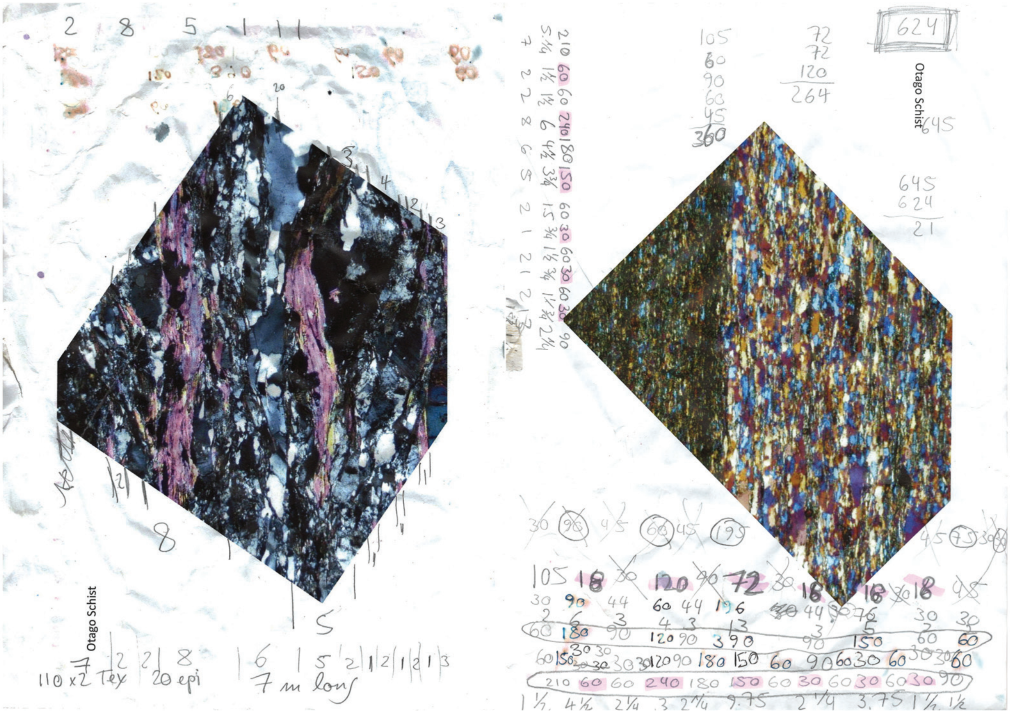

Figure 2. Otago Schist rock under the microscope. Each image represents a specimen 4 mm in width under the microscope, but has been enlarged and printed on A4 paper. The different colours represent individual minerals. The images show the effect of polarised light passing through minerals of differing composition and structure. Both samples are rock specimens from the most highly deformed parts of Otago. The handwritten notes were added by Christine Keller during the making of the work.

Here (Figure 2), 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 greys, blues, blacks and whites of the minerals feldspar and quartz;[4] (Figure 2). This layering forms from different mineral proportions, reflecting variations in the original sediment, being sand-sized or mud-sized.[5] Other minerals present in the rock include epidote, chlorite, amphibole and stilpnomelane, with accessory amounts of titanite, garnet, zircon and pyrite.[6]

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 (Figure 1). This represents the deepest parts of the schist rock now exposed at the surface in New Zealand through uplift and erosion.[7] Even more highly metamorphosed and deformed rocks are likely still buried beneath Otago.[8]

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

INSPIRATION

Christine Keller recalls:

"… my father from my childhood who, as a teacher, spent a huge amount of time researching mineral and metal crystal structures. He wanted to be able to visualise the theory and to understand what the science told him. This was at a pre-internet time and without access to my go-to 'auntie google.' He turned to experiments instead. He searched for the right orb to represent carbon and other atoms, trying out ping-pong and swimming pool cover balls, and finally settling on small nylon balls. These experiments meant our house was full of spheres glued together to form conglomerates or crystal structures. Other memorable experiments included blowing dishwashing liquid through a thin hose onto the surface of the bathtub to understand the organisation of grain boundaries between different crystals. Life became even more exciting when my father gained access to an electron microscope and we could watch crystals grow and experiment with polarised light. With this background, I was primed to work with a geologist and, at the introductory sessions for the 2019 project, I found my match in Dr Adam Martin of GNS Science, who showed colourful pictures of rocks under the microscope. It was the Otago Schist rock that caught my eye."

Adam Martin writes:

"I grew up surrounded by people interested in rocks and the world around them, and also grew up visiting art galleries and art exhibitions. During my undergraduate studies, I became fascinated with the practice of studying rocks under the microscope (petrology) and the world of spectacular colours and patterns this reveals. So I was excited and motivated when the opportunity arose to work with Christine to translate this into an art piece. I felt the colour and tactile nature of weaving was especially well suited to Otago Schist rocks as they look under the microscope."

PROCESS

A bonus of the collaboration between artist and scientist was a field trip organised by Adam for Christine and her husband. The three of us visited the Maniototo district to see the rocks and the landscape that inspired the work (Figure 1).

Christine recalls:

"Adam reminded me that the rock was from the Maniototo district in Otago and asked me if I had materials from that area – which I did. I used wool from sheep raised at Armidale in the Maniototo and spun in the now defunct Milton Mill. This local yarn I used to represent the mineral mica (bright colours; Figure 2) in the work. The other material used was a superfine merino yarn to represent the quartz and feldspar minerals in the work. This yarn originates either from Australia or New Zealand, is spun in Italy, purchased in Germany and brought back to New Zealand, and so has quite a carbon footprint 'yarn' to tell.

I prepared various warps that were dyed for different colour effects, based on the photographs taken under polarised light. The warps were 10m long. The loom used for this project was a 16-shaft compu-dobby with two warp beams, which gives one a choice to weave more than one layer under different warp tensions. The loom was warped with one predominantly anthracite in colour on one beam, and the other one dyed in greys and purples on the second beam.

During the weaving process, the serendipity with which a rock is pulled, stretched and cooked during its history inspired me. The exact outcome for a rock is not predetermined, even though the parameters of the process are somewhat clear, and I wanted to adopt a similar approach in my work. Weaving is a complex technique, where the weaver typically plans where and how the two thread systems – warp and weft – intersect. I had a general idea in mind for the weaving (Figure 3), but not a strict threading or lift plan. For this work I took a more free-form approach. While maintaining the integrity of the fabric with a certain number of threads to hold the piece together, I could let the other threads float freely.

All was going very well, but then lockdown hit.

It was not until January 2021 that I restarted the weaving. I recalled the weaving parameters I had set, but not the exact threading. So, I wove intuitively, always responding to the last little bit, evolving the work with time."

Figure 3. Fabric inspirations – some fabric samples I chose in order to roughly estimate a technique which I thought suitable for creating a response to the rock type and layered geological processes under consideration.

OUTCOME

Figure 4. The three original panels to come out of the collaboration.
Adam Martin holds the first, felted panel at the first viewing in Dunedin's LoomRoom.

Christine recalls:

"Three panels emerged (Figure 4). The first one was felted, as is my normal process. However, I was surprised when panels two and three spoke to me, asking not to be felted (Figure 4). Panel two is a single-layer fabric with lots of floating threads. The third panel is a double weave (Figure 5), which I truly enjoyed as a new piece of work, the likes [of which] I have never done before. I was thinking of the women weavers at the Bauhaus and, training-wise, one could call me a grandchild of the Bauhaus school. This third panel has inspired me to want to push my work further than I have been doing for a long time. Recently, I have dedicated my time to set up and run a weaving studio (Figure 4) that works for many as a community workshop and has been very rewarding. But now I feel it is also time I give myself more space to research and create my own favourite weaving works. I am so thankful that Adam Martin has stayed alongside my work through all the steps of the process."

Figure 5. Installation image of *Otago Schist* in Dunedin May 2021.

German-born, New Zealand-based artist **Christine Keller** holds an MFA from Concordia University (2004) in Montreal, Canada, and a Masters equivalent from Gesamthochschule Uni Kassel (1994), Germany. Christine has exhibited her award-winning work nationally and internationally since 1987. She was the academic leader of the Textile Section of Dunedin School of Art at Otago Polytechnic from 2005 to 2010. In late 2012 she founded the Dunedin-based weaving studio Weaving on Hillingdon, and in 2015 the community space known as Dunedin's LoomRoom. This is the fourth Art+Science project she has joined. As an immigrant to New Zealand, Christine took New Zealand Citizenship in 2016.

Adam Martin (ORCID ID: https://orcid.org/0000-0002-4676-8344) is a senior scientist working for GNS Science. As a geologist, his main interest is understanding how chemicals and minerals influence how the world works and how they interact with humans. Adam specialises in volcanoes, the deep Earth, Antarctica, soils and the Otago Schist. He studied his undergraduate degree at Monash University, Australia, before undertaking his doctorate at Otago University, New Zealand. This was followed by a three-year post-doc with the Natural Environment Research Council, UK, and a European Union Marie Curie Fellowship at the Bayerisches Geoinstitut in Germany. His research has been undertaken on every continent.

Acknowledgements

We would like to thank Steve Ting and Sam Patrick (of Dunedin's LoomRoom) for help with threading the floor loom. Adam Martin was supported through this project by funding from GNS Science.

1 EH Brown, "Metamorphic Structures in Part of the Eastern Otago Schists," *New Zealand Journal of Geology and Geophysics*, 11 (1968), 41-65.

2 JD Campbell and G Warren, "Fossil Localities of the Torlesse Group in the South Island," *Transactions of the Royal Society of New Zealand*, 3 (1965), 99-137; CJ Adams, HJ Campbell and WL Griffin, "Provenance Comparisons of Permian to Jurassic Tectonostratigraphic Terranes in New Zealand: Perspectives from Detrital Zircon Age Patterns," *Geological Magazine*, 144:4 (2007), 701-29.

3 N Mortimer, "New Zealand's Geological Foundations," *Gondwana Research*, 7:1 (2004), 261-72.

4 EH Brown, "The Geology of the Mt Stoker Area, Eastern Otago," *New Zealand Journal of Geology and Geophysics*, 6:5 (1963), 847-71.

5 Ibid.

6 AP Martin, SC Cox and B Smith Lyttle, *Geology of the Middlemarch Area 1:50 000*, GNS Science Geological Map 5 (Lower Hutt, New Zealand: GNS Science, 2016).

7 N Mortimer, "A Provisional Structural Thickness Map of the Otago Schist, New Zealand," *American Journal of Science*, 303:7 (2003), 603-21.

8 N Mortimer, FJ Davey, A Melhuish, J Yu and NJ Godfrey, "Geological Interpretation of a Deep Seismic Reflection Profile Across the Eastern Province and Median Batholith, New Zealand: Crustal Architecture of an Extended Phanerozoic Convergent Orogen," *New Zealand Journal of Geology and Geophysics*, 45:3 (2002), 349-63.

9 Mortimer, "Geological Foundations."