Proceedings of the Enhanced Rock Weathering Research in Australia and New Zealand Symposium 2026

Cairns, Australia, 25 June 2026

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This volume includes abstracts of presentations at the 'Enhanced Rock Weathering Research in Australia and New Zealand Symposium 2026' held in Cairns, Australia on 25 June 2026, and provides links to video recordings of the oral presentations and copies of the posters.

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Oral Presentations

Authors	**Annette Cowie** New South Wales Department of Primary Industries and Regional Development, Armidale
Title	The role of carbon dioxide removal in meeting net zero targets
Abstract	Achieving the temperature goal of the Paris Agreement requires not only rapid and deep reductions in greenhouse gas emissions, but also the large-scale deployment of carbon dioxide removal (CDR) to balance residual emissions and achieve net zero. As highlighted by the IPCC Sixth Assessment Report, CDR is unavoidable if global net zero greenhouse gas emissions are to be achieved. The presentation reviews the role of CDR in climate change mitigation, describing the biological, geochemical and engineered approaches available, including reforestation, soil carbon sequestration, biochar, bioenergy with carbon capture and storage (BECCS), direct air carbon capture and storage (DACCS), and enhanced rock weathering. It explains how methods differ in terms of CO_2 capture process, storage durability, technological maturity, mitigation potential, costs, sustainability considerations, and scalability. While there is growing global interest in CDR, there is a widening gap between current deployment and the levels required to limit warming to 1.5°C. Conventional land-based removals currently dominate global CDR, but novel approaches are expanding rapidly, supported by the voluntary carbon market and corporate net zero commitments. The forthcoming IPCC Methodology Report on Carbon Dioxide Removal Technologies and Carbon Capture, Utilization and Storage will provide guidance for incorporating novel CDR methods such as enhanced rock weathering into national greenhouse gas inventories.
Recording	View presentation video (https://www.youtube.com/watch?v=Mhrhi8e8aWc)

Authors	**Paul Nelson**[1], Wolfram Buss[2], Binoy Sarkar[3] [1]James Cook University, Cairns, [2]Australian National University, Canberra, [3]Adelaide University, Adelaide
Title	Enhanced rock weathering research: the context
Abstract	Over the Earth's history, natural weathering of silicate rock by carbonic acid has converted most of the carbon on Earth into the form of limestone. This century, human acceleration of this process by applying crushed alkaline silicate rock (e.g. basalt) to agricultural land has been proposed to help arrest the rise in atmospheric carbon dioxide concentration. Enhanced rock weathering (ERW) is known to improve most soils, and significant carbon capture rates have been predicted. This encouraging outlook has led to formation of numerous startups deploying ERW globally. ERW is currently considered one of a handful of promising carbon capture technologies by governments and industry, and interest is growing. Australia and New Zealand have abundant agricultural land suitable for deployment near basalt sources. However, the small but growing number of field trials are generally showing lower levels of carbon capture than initially projected. Current research is examining reasons for this, gaining a wholistic appreciation of benefits and costs, and working to optimise benefits. In this symposium we will hear about the latest research on modelling processes and

	deployment, social acceptance, and mechanisms of carbon capture measured in laboratory, pot and field trials in Australia and New Zealand.
Recording	View presentation video (https://www.youtube.com/watch?v=nI9H897VrcM)

Authors	**Euripides Kantzas**[1], Mark Lomas[1], Maria Val Martin[1], Lyla Taylor[1], Shuang Zhang[2], Rafael M. Eufrasio[1], Mohammad Madankan[3], Eva Alexandri[4], Christopher T. Reinhard[5], Noah Planavsky[6], Lenny S. Koh[1], David Purdy[7], Hector Pollitt[8], Phil Renforth[3], David Beerling[1] [1]University of Sheffield, UK, [2]Texas A&M University, USA, [3]Heriot-Watt University, UK, [4]Cambridge Econometrics, UK, [5]Georgia Institute of Technology, USA, [6]Yale University, USA, [7]Department of Resources, Geological Survey of Queensland, Australia, [8]World Bank, USA
Title	Constraints and challenges in deploying enhanced rock weathering with agriculture for CO_2 removal at national scales: a case study for Australia
Abstract	Not available
Recording	Not available

Authors	**Kerryn Brent**[1], Yuwan Malakar[2], Talia Jeanneret[2], John Gardner[2] [1]CSIRO, Hobart, [2]CSIRO, Brisbane
Title	Great expectations: how stakeholders see field trials contributing to responsible enhanced rock weathering
Abstract	Field trials are being proposed and/or conducted for enhanced rock weathering (ERW) and other mineral carbonation (MC) approaches for carbon dioxide removal. Field trials are important to progress the development of these technologies beyond theoretical and laboratory research and assess their benefits and impacts in real-world settings. This study considers the significance of field trials from a social science perspective. We interviewed 36 Australian stakeholders regarding what they believe is important for ERW and other MC approaches to be deployed responsibly. In > 80% of interviews, participants emphasised the importance of field trials for responsible deployment. We examine participants' responses to understand how and why they expect field trials to promote socially responsible outcomes. We demonstrate how participants' expectations align with key dimensions of responsible innovation, such as anticipating risks and co-benefits, and the inclusion of non-researchers in the innovation process. Our results emphasise the important role field trials can play in bolstering social acceptance. We identify stakeholder priorities that could shape field trial design to enhance the perceived legitimacy and trustworthiness of ERW and MC technologies.
Recording	Not available

Authors	**Balwant Singh**, Zongtang Yang University of Sydney, Sydney
Title	Constrains in measuring carbon sequestration potential of ERW and its evaluation in horticultural crops
Abstract	Enhanced rock weathering (ERW) has gained significant attention from researchers because of its significant potential to sequester CO_2 and contribute to climate change mitigation. ERW involves land application of finely ground rock, such as basalt, containing abundant silicate minerals to accelerate carbon capture. Similar to natural chemical weathering, in the ERW process silicate minerals react with carbonated water resulting in by-products that include base cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}), bicarbonate (HCO_3^-) anions and dissolved silica (H_4SiO_4) or precipitation of secondary aluminosilicate minerals. The weathering of rock silicate minerals consumes CO_2 from the atmosphere and/or soil that is sequestered over geological timescales. A wide range of CDR potential of ERW has been reported in different studies and values are mostly based on modelling approaches, with few small-scale mesocosm experiments. Several approaches, including total alkalinity, base cations, total inorganic carbon, pH, and isotopic ratio of elements, have been used to measure CO_2 sequestration from ERW. However, there is lack of consensus on this because of the limited experimental data using variable approaches. The presentation will discuss these approaches in detail and suggest strategies to obtain experimental results that could potentially be used in future experiments.
Recording	View presentation video (https://www.youtube.com/watch?v=zKzM6HBCNEQ)

Authors	**Wolfram Buss** Australian National University, Canberra
Title	Organic-inorganic interactions in enhanced rock weathering: Implications for carbon dioxide removal
Abstract	Enhanced rock weathering (ERW) is increasingly recognised as a promising strategy for carbon dioxide removal, primarily through the application of silicate minerals to agricultural soils. Although the inorganic geochemical processes involved ERW are often considered relatively well understood, recent findings suggest that they may be more complex than previously thought. Moreover, emerging evidence suggests that silicate rock amendments can significantly influence the soil organic carbon (SOC) cycle, both positively and negatively. These interactions are complex and context-dependent, with outcomes varying across soil types, climates, and management practices. In this presentation, I will synthesize current understanding of how ERW affects SOC dynamics, drawing on recent field and laboratory data. I will highlight the potential for ERW to enhance SOC sequestration, as well as the risks of unintended carbon losses, and discuss methodological challenges in quantifying these effects. Ultimately, this work underscores the need for integrated assessments of ERW that account for both inorganic and organic carbon fluxes to accurately evaluate its net climate mitigation potential.
Recording	View presentation video (https://www.youtube.com/watch?v=jq4Gq-bPx4o)

Authors	**Yiwen Zhang** Nanyang Technological University, Singapore, Earth Observatory of Singapore
Title	Potentials of enhanced rock weathering carbon insetting in Southeast Asia and Australia to build a more sustainable supply chain: Life-cycle and techno-economic analysis (LCA-TEA)
Abstract	Enhanced Rock Weathering (ERW) is increasingly recognised as a promising durable carbon dioxide removal (CDR) pathway, yet its large-scale deployment remains constrained by uncertainties in life cycle emissions, economic feasibility, and measurement, reporting, and verification (MRV), particularly across diverse geographical contexts. This study presents an integrated cradle-to-farm-gate Life Cycle Assessment (LCA) and Techno-Economic Analysis (TEA) of ERW deployment across two contrasting regions: Southeast Asia and North Queensland, Australia.
Recording	View presentation video (https://www.youtube.com/watch?v=SmIlZy0ge-U)

Authors	**Meila Picard**, Peter Almond, Nigel Beale, Jinhua Pan Lincoln University, Christchurch
Title	Baseline silicate weathering rates and CO_2 drawdown following basalt application in a New Zealand sheep farm
Abstract	The chemical weathering of silicate rocks generates carbonate alkalinity leading to the long-term storage of atmospheric carbon dioxide (CO_2) in global oceans. Accelerating the weathering of silicate rocks by applying them in a ground form over agricultural landscapes, known as enhanced rock weathering (ERW), may act as a highly effective climate change mitigation strategy by sequestering a proportion of anthropogenic greenhouse gas emissions. We assessed the variability of silicate weathering processes within a grazed pasture landscape formed in loess in Southland, New Zealand by utilising the artificial mole and tile drainage system on-farm. We quantified HCO_3^- flux normalised for catchment area in drainage water over one year from two small catchments (< 5 ha) to better understand baseline CO_2 removal from which the efficacy of ERW could be determined. Baseline silicate weathering rates in the two catchments were 148.9 (± 1.09) and 139.2 (± 0.96) kg ha^{-1} $year^{-1}$. We will present the HCO_3^- flux following one year of basalt weathering and discuss the sensitivity of the flux to weather variability. These findings will aid our understanding of the efficacy of ERW in pastoral systems for CO_2 removal and the reliability of aqueous phase measurements to detect a weathering signal.
Recording	View presentation video (https://www.youtube.com/watch?v=PafGfaISA7M)

Authors	**Aydin Enez**[1],Lambert Brau[1], Christiana A. Dietzen[2], Franky Barton[2], Malgorzata Rizzi[2], Minik T. Rosing[2] [1]Deakin University, Geelong, [2]University of Copenhagen, Denmark
Title	Rocking the crop: A national-scale investigation of glacial rock flour efficacy in Australian cropping systems
Abstract	Agriculture is a major contributor to Australia's economy, with export values forecasted to reach $99.5 billion AUD (2025–2026 FY). However, the nation's diverse cropping systems—differing in climate, soil type, and irrigation requirements—face increasing pressures from climate variability, rising fertiliser costs, and the substantial carbon footprint from intensive production. Glacial rock flour (GRF) has emerged as a potential solution capable of enhancing soil fertility through the gradual release of plant nutrients and promoting CO_2 drawdown through enhanced weathering processes. Here, we conducted a three-year investigation of GRF across ten Australian cropping systems situated in WA, NSW, SA, and QLD. We trialled multiple GRF application rates (10 – 50 t/ha) and assessed changes in crop yield, soil physicochemical properties, and plant nutrient quality. Crop models included sugarcane, maize, canola, wheat, barley, lentil, field pea, and chickpea. Overall, GRF application produced the most pronounced positive effects in sugarcane systems, whereas other cropping systems exhibited lesser or occasional negative responses. By analysing the roles of the environment and management practices, we identified key drivers influencing GRF weathering in Australian systems. These results provide a framework for understanding how GRF can be productively integrated into Australian agriculture to support fertility, sustainability, and carbon mitigation objectives.
Recording	View presentation video (https://www.youtube.com/watch?v=KsMHelKJxPk)

Authors	**Sofonyas Tefera**[1], Fredrick Holden[1], Dylan Murphy[1], Michael Gailer[1], Rosalie Tostevin[2], Kirstine Skov[3], Xin Ran Liu[4], Paul Nelson[1] [1]James Cook University, Cairns, [2]UNDO Carbon, UK, [3]Independent researcher, Austria, [4]The University of Edinburgh, Scotland
Title	Effect of soil management on carbon dioxide removal via enhanced rock weathering under sugarcane in the tropics
Abstract	This study was initiated to determine the effects of soil management practices on carbon dioxide removal (CDR) via weathering of crushed basalt applied to slightly acidic soil under sugarcane. A field experiment was established in Cairns, Australia in 2024, with a factorial combination of two basalt rates (0 and 50 t ha^{-1}, <4 mm) and four soil management practices (different combinations of mulch, lime and fertiliser), with six replicates. Soil, leachate and crop yield data were collected in 2025-2026. In soil (0 to 10 cm), basalt application increased exchangeable Na, extractable P and Si, indicating significant weathering, but pH was not significantly raised. Soil management treatments influenced most of the soil variables at 0-10 cm. However, soil deeper than 10 cm was generally unaffected by any of the treatments. Sugarcane stalk and leaf yields were unaffected by basalt, but stalk weight was higher with the application of mulch, lime and fertilizers. Alkalinity export, i.e. CDR, was not affected

	by basalt, soil management or their interaction. While the results showed that practices to increase soil pH and soil pCO_2 did not increase CDR in the first year, monitoring will be continued to determine if effects take longer to manifest.
Recording	View presentation video (https://www.youtube.com/watch?v=a3ql1hohuy8)

Authors	**Fredrick Holden**, Dylan Murphy, Paul Nelson James Cook University, Cairns
Title	Mechanisms limiting carbon dioxide removal via enhanced weathering of basalt in the field
Abstract	High potential rates of carbon dioxide removal (CDR) via enhanced rock weathering (ERW) have been suggested, however rates measured in field trials are much lower. Mechanisms limiting CDR are understood in acidic soils but not in neutral soils. In this study we established a range of soil pH values and measured CDR via ERW under sugarcane. The treatments were annual applications of basalt (50 t ha^{-1} a^{-1} 2018-2024), and lime (2.5 t ha^{-1} a^{-1} 2022-2024). In 2024-2025, CDR was 0.048 t CO_2 ha^{-1} a^{-1} with basalt alone but less in treatments with higher pH due to lime application (p=0.036 for basalt*lime). Basalt increased soil pH, cation exchange capacity and exchangeable base cation contents down to 25 cm but not below. At neutral soil pH, sugarcane appeared to take up more N as nitrate. CDR was limited mostly by release of protons from variable-charge materials. At low pH these released protons were a major weathering agent, whereas at higher pH they converted bicarbonate to carbon dioxide, thereby negating CDR. All soils contain variable-charge materials (organic matter and oxides) and generate acidity by nitrification, so these mechanisms will limit CDR via ERW in all soils.
Recording	Not available

Authors	**Thilini Amarasinghe**[1], Binoy Sarkar[1], Enzo Lombi[1], Justine Payne[1], Amanda Schapel[2] [1]Adelaide University, Adelaide, [2]Department of Primary Industries and Regions, South Australia
Title	Repurposing basalt for carbon dioxide capture and healthy food production
Abstract	Enhanced rock weathering (ERW) with finely ground basalt offers simultaneous benefits for atmospheric CO_2 capture and soil fertility, yet its interaction with nitrogen (N) fertilisation remains unclear. This greenhouse study examined how varying basalt (0–100 t ha^{-1}) and urea (50–150 kg N ha^{-1}) rates influence CO_2 capture potential, soil chemistry, and wheat (*Triticum aestivum*) performance using an acidic loam soil from Mallala, South Australia. After harvest, soil, porewater, and plant tissues were analysed to assess changes in pH, exchangeable cations, carbon pools, and N uptake. Post experimental soil pH increased progressively with basalt application, from 4.64 in the control to 5.80 at 100 t ha^{-1} ($p < 0.05$). Within each basalt treatment, soil pH declined with increasing urea rate, reflecting acidification from urea hydrolysis and nitrification that partially counteracted basalt's buffering effect. Soil cation exchange capacity (CEC) also increased with basalt addition, from 10.68 to 20.08 $cmol_+$ kg^{-1} ($p <$ 0.05), but decreased slightly under higher urea rates, likely due to N induced

	acidification. Consistent with these soil responses, shoot biomass increased with basalt rate. The study provides insights into how N fertiliser rates influence basalt application, offering guidance for optimising ERW strategies for sustainable carbon capture and crop production.
Recording	View presentation video (https://www.youtube.com/watch?v=ij840XVkbIo)

Authors	**Thomas R. Jones**[1], Bobby Pejcic[2], Cathryn O'Sullivan[1], Anicia Henne[2], Renee Birchall[2], Dio Antille[3], Jonathan Anderson[2], Anton Wasson[3] [1]CSIRO, Brisbane, [2]CSIRO, Perth, [3]CSIRO, Canberra
Title	Enhanced rock weathering in unfavourable agricultural landscapes
Abstract	Enhanced Rock Weathering (ERW) represents a promising CO_2 removal strategy, yet mechanistic understanding primarily derives from humid environments. Australian semi-arid regions present fundamentally different conditions where weathering proceeds through nanometre-scale water films, raising critical questions about ERW feasibility across dryland agriculture. We evaluated 18 Australian basalt rock flours under controlled, dry CO_2 exposure. CO_2 uptake varied five-fold (0.2-1.6 wt.%), revealing a fundamental divergence between provenance and performance. Strikingly, commercial amendments exhibited some predictable compositional links - MgO (R^2 = 0.94), augite (R^2 = 0.95) - yet achieved modest uptake (0.2-1.2 wt.%). Quarry materials showed negligible correlations but superior carbonation (up to 1.6 wt.%), challenging conventional Ca + Mg screening protocols. Under moisture limitation, surface processes may govern rates independently of chemistry and mineralogy. Given ERW's inherently slow kinetics under these constraints, we further investigated whether microbial communities could accelerate mineral dissolution. Laboratory experiments over 18 months compared quarry-derived consortia against native soil microbiomes in acidic and alkaline soils. Microbial effects proved context-dependent: inoculated consortia accelerated carbonation in alkaline soils, while native communities performed better in acidic conditions. These findings demonstrate carbonation can proceed under Australia's dry conditions, though surface characteristics and microbial dynamics emerge as critical rate-controlling factors requiring further investigation.
Recording	View presentation video (https://www.youtube.com/watch?v=XhROW6AR13M)

Authors	**Lakshmi Chamaparambil Suresh**[1], Binoy Sarkar[1], Enzo Lombi[1], Casey Doolette[1], Birhanu Iticha Ayanssa[1], Brian Hughes[2], Juraj Farkas[1], Paul Nelson[3] [1]Adelaide University, Adelaide, [2]Department of Primary Industries and Regions, South Australia, [3]James Cook University, Cairns
Title	Determining acid neutralisation capacity of crushed basalt
Abstract	Enhanced rock weathering (ERW) is a promising carbon dioxide (CO_2) removal strategy involving application of crushed alkaline silicate rocks to agricultural soils. In addition to atmospheric CO_2 drawdown, ERW can improve soil fertility by increasing pH and supplying nutrients. Basalt, a Ca- and Mg-rich mafic rock, is suitable due to its

	favourable mineralogy, relatively rapid weathering rate, and widespread availability as a fine-grained (< 4 mm) quarry by-product. This study focused on the weathering rate, base cation release, and acid neutralization capacity (ANC) of basalt, which holds potential as an alternative to agricultural lime for correcting soil acidity. Three basalts from South Australia, Queensland, and New South Wales were physically and chemically characterized. Particle size analysis showed *p*80 values (80% particles smaller than) ranging from 1,454 to 1,710 µm. Elemental analysis revealed high concentrations of Ca (56.33–73.30 g/kg), Mg (34.78–49.77 g/kg), and K (16.84–26.36 g/kg), indicating strong nutrient supply potential, while As (0.86–2.75 mg/kg) and Cd (0.08–0.35 mg/kg) were low. ANC is being determined through titration and a 6-month soil incubation experiment in which basalt (several particle size fractions) or lime (pure $CaCO_3$ or agricultural lime) has been added to two acidic South Australian soils from Mallala and Yumali with initial pH values of 4.57 and 4.72 in $CaCl_2$, respectively. The findings will provide insights into the industrial relevance of utilizing basalt as an alternative soil acidity neutralizing amendment.
Recording	View presentation video (https://www.youtube.com/watch?v=RR96kTQ2zcM&pp=0gcJCf4LAYcqIYzv)

Authors	**Hannah Green**[1], Paul Nelson[2] [1]James Cook University, Townsville, [2] James Cook University, Cairns
Title	Carbon dioxide removal via enhanced rock weathering: Understanding mechanisms and the effect of soil properties
Abstract	Most research into ERW has focused on the material applied and taken little account of the soil. Our aim was to determine the effects of soil properties on CDR via ERW. Using geochemical modelling, we simulated CDR with a) a range of typical soil and climatic conditions, b) nitrification reactions and addition of nitrogen fertilisers, and c) mechanistic pH buffering capacity using exchange site chemistry. Based on our modelling, the optimum soil pH for CDR via ERW is around 6.5, but CDR also depends strongly on soil pH buffering capacity and carbon dioxide concentrations. Highly weathered acidic soils and soils with high pH buffering capacity have a large pool of reserve acidity that prevents or reverses CDR. Similarly, addition of nitrogen fertilisers generates strong acids during nitrification that rapidly weather applied materials without CDR. As such, there is a risk the growing ERW industry may be a net emitter of carbon, particularly in acidic soils. Additionally, inadequate modelling of soil pH buffering capacity and other soil properties will lead to significant overestimates of CDR.
Recording	View presentation video (https://www.youtube.com/watch?v=8x4-U5NsYgI)

Posters

Authors	**Peter Almond**, Meila Picard, Nigel Beale, Jinhua Pan Lincoln University, Christchurch
Title	Effects of basalt weathering on agronomically relevant soil and herbage properties in a New Zealand sheep farm
Abstract	The chemical weathering of silicate rocks generates carbonate alkalinity leading to the long-term storage of atmospheric carbon dioxide (CO_2) in global oceans. Accelerating the weathering of silicate rocks by applying them in a ground form over agricultural landscapes, known as enhanced rock weathering (ERW), may act as a highly effective climate change mitigation strategy by sequestering a proportion of anthropogenic greenhouse gas emissions. The weathering of silicate rocks, such as basalt, in agricultural soils may provide ancillary benefits to the productive system through the release of base cations thus providing a liming effect and an increase in beneficial nutrients such as phosphorus. We assessed baseline soil and herbage (ryegrass/white clover) properties across a 5 ha area on a sheep farm located in Southland, New Zealand prior to and following the application of 50 t ha^{-1} crushed basalt. We will present changes in soil pH, bulk density, Olsen P and general soil and herbage macro/micro-nutrient concentrations prior to and following > 1 year of basalt weathering. These findings will provide important context for the potential co-benefits of ERW in New Zealand pastoral agriculture systems.
Poster	View poster

Authors	**Paul Nelson**[1], Fredrick Holden[1], Amanda Neilen[2] [1]James Cook University, Cairns, [2]Consolidated Pastoral Company, Brisbane
Title	Enhanced rock weathering for carbon dioxide removal in a grazed tropical savanna
Abstract	Enhanced rock weathering is a promising CO_2 removal (CDR) technology, but its effectiveness will be governed largely by climate and soil, so field trials are essential. A vast area of tropical savannas may be conducive due to a hot wet season. We established a field trial on Wrotham Park station (16°32'S, 143°58'E). This area had an annual rainfall of 384 to 1818 mm (mean 953 mm) over the 2010-2025 period. The soil is black Vertosol with pH1:5 soil:water of 6.29 to 7.52 (at 0-5 and 30-50 cm), total (organic) carbon content of 2.38 to 0.64 % and cation exchange capacity of 27.9 to 33.1 $cmol_{(+)}$ kg^{-1}. Crushed basanite (< 4 mm) was surface applied at zero or 100 t ha^{-1} over 6 replicate plots in 2024. After one year, soil properties were significantly affected at 0-5 cm depth but not below. At 0-5 cm, basanite increased soil pH by 0.11 unit. However, exchangeable base cation content decreased by 3.25 $cmol_{(+)}$ kg^{-1} and there was no detectable change in total inorganic carbon content. The results suggest that there may be CDR via carbonate precipitation at this site but more sensitive analysis of inorganic carbon may be necessary.
Poster	View poster

Authors	**Paul Nelson**[1], Binoy Sarkar[2], Fredrick Holden[1], Birhanu Iticha Ayanssa[2], Sofonyas Dargie Tefera[1], Lakshmi Chamaparambil Suresh[2], Lily Reid[2], Andrew Pedley[3], Rhys Heffernan[3], James Lyons[3], Amanda Neilen[4], Lyn Dohle[5], Karen George[6], Angela Strain[1] [1]James Cook University, Cairns, [2]Adelaide University, Adelaide, [3]Carbonaught, Brisbane, [4]Consolidated Pastoral Company, Brisbane, [5]Dept. of Primary Industries and Regions South Australia, Kingscote, [6]TNQ Drought Hub, Cairns
Title	Enhanced rock weathering: field trials with basalt on farms across Eastern Australia
Abstract	Enhanced rock weathering is proposed as a way of improving soil quality and crop productivity while capturing CO_2. Robust evaluation of its potential requires field trials and engagement with farmers, produce markets and regulators. In 2024-26 we established replicated field trials in collaboration with farmers across a range of climates, soil types and agricultural systems in eastern Australia: irrigated bananas and avocados on a Ferrosol and grazed savanna on a Vertosol in Far North Queensland, grain on a Vertosol in Central Queensland, cotton on a Vertosol in southern Queensland, irrigated rice on a Vertosol in New South Wales, irrigated dairy on a Chromosol in Victoria and grain on a Chromosol in South Australia. Basalt (commercially available by-product 'crusher dust') has been spread at zero and 40 t/ha at most sites, with some sites having lower or higher rates, or combinations of basalt with lime or fertilisers. Monitoring of crop or pasture and soil has commenced at all sites, deep drainage at most sites, and runoff and soil CO_2 concentration at one site. The trials will run until 2027-2028, and results will inform optimal deployment of enhanced rock weathering in Australian agricultural systems.
Poster	View poster

Authors	**Yiwen Zhang**[1,2], Jinyin Xia[1], Hannah Green[3], Paul Nelson[4], Simon A.T. Redfern[1,2] [1] Nanyang Technological University, Singapore, [2]Earth Observatory of Singapore, [3]James Cook University, Townsville, [4] James Cook University, Cairns
Title	Potentials of enhanced rock weathering carbon insetting in Southeast Asia – Australia corridor to build a more sustainable supply chain
Abstract	Enhanced Rock Weathering (ERW) is increasingly recognised as a promising durable carbon dioxide removal (CDR) pathway, yet its large-scale deployment remains constrained by uncertainties in life cycle emissions, economic feasibility, and measurement, reporting, and verification (MRV), particularly across diverse geographical contexts. This study presents an integrated cradle-to-farm-gate Life Cycle Assessment (LCA) and Techno-Economic Analysis (TEA) of ERW deployment across two contrasting regions: Southeast Asia and North Queensland, Australia.
Poster	View poster

Authors	**Lily Reid**[1], Binoy Sarkar[1], Fredrick Holden[2], Paul Nelson[2], Birhanu Iticha Ayanssa[1], Thilini Amarasinghe[1], Enzo Lombi[1], James Lyons[3] [1]Adelaide University, Adelaide, [2]James Cook University, Cairns, [3]Carbonaught Pty Ltd, Brisbane
Title	Effects of crushed basalt application on the organic carbon content of an orchard soil
Abstract	Enhanced rock weathering (ERW) is an emerging approach that offers the potential for atmospheric CO_2 removal and soil carbon storage, as well as correcting soil acidity. Of particular interest is the organic carbon storage pathway of ERW, which involves the interaction of ERW-generated cations and/or secondary minerals with soil organic material. To date, this topic remains relatively unexplored. This project aims to investigate how the complex mechanisms involved in organic carbon storage evolve spatiotemporally in an orchard soil following crushed basalt application. Basalt was applied to an avocado orchard in July 2025. The trial site is located in Far North Queensland and has a humid, subtropical climate with well drained, slightly acidic soil. By using a robust range of methodologies, we aim to quantify the interaction of ions with soil exchange sites and their complexation by soil organic matter, as well as the precipitation of secondary minerals via the interaction of the basalt amendment with the orchard soils. It is anticipated the results of this project will aid the development of new models for determining net carbon capture and storage pathways.
Poster	View poster

Presenter and Editor Biographies



Peter Almond's research occupies the niche between soil science and the broader earth sciences. He applies his skills to understanding earth surface processes, biogeochemistry, natural hazards and paleoclimate and climate change over a range of time scales. His experience and knowledge allow him to bring a unique perspective to earth surface processes research that is complementary to other disciplines, including geology, geomorphology, geochronology, climatology. Most recently Ass. Prof. Almond has developed a research programme into ERW, deriving a method for quantifying CO_2 drawdown suitable for the NZ GHG inventory and engaging in fundamental field-scale research to determine efficacy of ERW in pastoral ecosystems.



Thilini Amarasinghe is a PhD candidate in Environmental Science at the Adelaide University, specialising in ERW and the repurposing of silicate minerals for carbon dioxide capture and sustainable food production. She holds a B.Sc. (Honours) in Chemistry from the University of Sri Jayewardenepura, Sri Lanka, and previously worked as a Research Scientist at the Industrial Technology Institute. Her research experience spans soil chemistry, nutrient solubilisation, and analytical techniques. Thilini's work integrates geochemistry, soil carbon dynamics, and climate-focused mineral transformations to advance sustainable agricultural and environmental solutions.



Kerryn Brent is a research scientist at CSIRO, Hobart specialising in environmental governance, climate change law and ocean governance. Her current research focuses on the governance of novel carbon dioxide removal, examining how to manage associated risks and uncertainties, and promote responsible innovation. Kerryn holds a PhD in Law from the University of Tasmania and BA/LLB from the University of Newcastle. Kerryn's broader research interests include law of the sea, and the governance of solar radiation management, green hydrogen and the restoration of blue carbon ecosystems.



Wolfram Buss is an ARC Industry and Senior Research Fellow within the Fenner School of Environment and Society at the Australian National University. He has a background in biology (BSc), environmental and agricultural sciences (MSc) and environmental chemistry and engineering (PhD). He investigates technologies and processes to sequester large amounts of carbon in agricultural/forestry systems, which have the potential to mitigate and eventually reverse the effects of climate change while also providing soil and plant co-benefits.



Lakshmi Chamaparambil Suresh is a PhD student at the Future Industries Institute, Adelaide University. She holds a BSc and MSc in Earth Science. Her research focuses on developing a high-precision metal isotope-based approach to quantify carbon sequestration through enhanced rock weathering (ERW). Her work includes developing and optimising isotopic techniques (e.g., Ca and Sr isotopes) in the laboratory and applying them to samples from glasshouse experiments and ERW field trials. Through this work, she aims to advance understanding of the processes controlling CO_2 and metal fluxes, improving the monitoring, reporting, and verification of CO_2 removal by ERW. Lakshmi is originally from Kerala, India.



Annette Cowie is a Senior Principal Research Scientist at the New South Wales Department of Primary Industries and Regional Development and has a background in agricultural science. Annette's research sits on the science-policy interface, supporting holistic responses to climate change, and sustainable land management. Her expertise includes greenhouse gas accounting for the land sector, soil carbon management and biochar science. Annette was a lead author in the IPCC's Sixth Assessment Report and is now co-authoring the Methodology Report on Carbon Dioxide Removal. She is a co-author of the first and second editions of The State of Carbon Dioxide Removal.



Aydin Enez is a Research Fellow from the School of Life and Environmental Sciences at Deakin University, Victoria. Dr Enez completed his PhD in 2021 (Deakin University) under the supervision of Professor Lambert Brau, with his research focus aimed at understanding novel roles of plant-microbe interactions to reduce stress in cropped plants. Since then, his research expertise has transitioned towards investigating novel, innovative, and sustainable solutions for soil health improvement. Recently, Dr Enez's research has explored the agricultural application of Greenlandic glacial rock flour to boost soil fertility while supporting carbon dioxide drawdown in Australian cropping systems.



Hannah Green completed a Bachelor of Advanced Science majoring in Ecology and Earth Science with a research Honours on sodic soil chemistry at James Cook University in Townsville. Hannah has remained at JCU and is now in their final year of a PhD in soil chemistry focused on optimising the use of mill by-products for soil improvement and carbon sequestration. Hannah is interested in continuing to work on improving soils, productivity, and sustainability in the future through agricultural systems modelling.



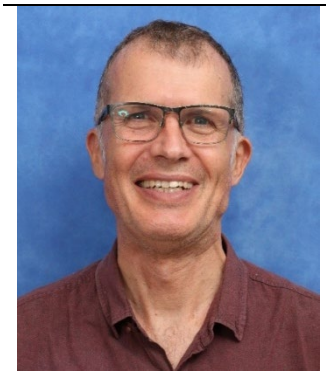
Fred Holden studied environmental science at James Cook University, where he now works as a Senior Research Associate. In this role, he manages several field trials examining the effect of enhanced rock weathering on crop productivity, soil health and carbon dioxide capture on sugarcane, bananas, avocadoes and grain in central and far north Queensland. Fred is a solution orientated research project manager, leading a large team and coordinating research activities with several commercial and research partners. His work on the effects of soil acidity on carbon capture via enhanced rock weathering had a wide impact on the industry.



Thomas Ray Jones is an interdisciplinary researcher focused on the interactions between microbes and minerals, and how these relationships drive geochemical cycling and carbon dioxide removal. Microbes have played a central role in Earth's carbon cycle for 3.5 billion years, and while thermodynamics determines what can happen at surface and subsurface conditions, it is microbial communities that can mediate what actually happens, and at what rate. Working within CSIRO's CarbonLock Future Science Platform, Thomas investigates how these communities accelerate silicate weathering, carbonate formation, and nutrient cycling in agricultural soils – and how ERW might perform under the moisture-limited conditions that define much of the Australian landscape.



Euripides Kantzas is a data scientist at the Leverhulme Centre for Climate Change Mitigation. He studies the potential of CO_2 removal through Enhanced Weathering at national scales, under different climate scenarios and macroeconomic projections. His work involves assimilating data and geochemical models in optimisation routines to estimate deployment scale, costs, and associated emissions of enhanced weathering. He also develops machine learning emulators of geochemical models to accelerate computations and maintains databases to support data management and dissemination for research and decision-making.



Paul Nelson is a soil scientist who has been working at the agricultural-environmental interface for 35 years. He studies relationships between soil properties, soil management, crop productivity, water quality and greenhouse gas emissions. Over the past 25 years he has worked mostly in Papua New Guinea, Indonesia and northern Australia. His current focus is on soil carbon cycling and the effects of enhanced rock weathering on carbon dioxide capture. He works at James Cook University in Cairns.



Meila Picard is a PhD student at Lincoln University interested in the role of soils for natural carbon capture and climate change mitigation. Her PhD aims to investigate the potential of enhanced rock weathering for carbon capture in a New Zealand pastoral agricultural system. This includes the implications for wider aspects of the productive system such as trace element accumulation and changes to soil fertility.



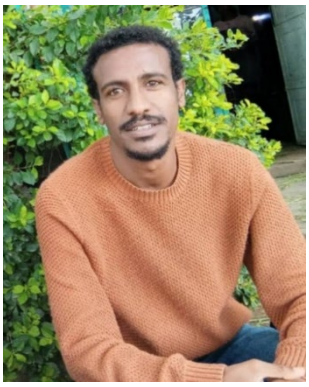
Lily Reid's current research focusses on resolving the organic carbon storage pathways of enhanced rock weathering processes in high-value orchards. This project investigates how the application of basalt rock as a soil amendment works to potentially remove atmospheric carbon dioxide and store it within agricultural soils, while improving overall soil health and productivity. She was awarded her PhD from the University of South Australia in 2020 for her work on the palaeoecology and palaeoenvironments of the Ediacara biota. This work seeks to reconstruct past environments and employs a range of methodologies including sedimentology, facies analysis, sequence stratigraphy and detrital zircon geochronology.



Binoy Sarkar is a Senior Research Fellow at the Future Industries Institute of Adelaide University where he leads the Land-based Negative Emission Technologies research concentration. His work focuses on evolving and interlinked environmental sustainability issues around climate change, food security, and environmental quality. Over the past 15 years, he has engaged in developing and testing novel nature-based methods for removing carbon dioxide from the atmosphere, storing carbon in soil, improving soil quality and plant production, and cleaning up environmental pollutants. He previously worked at the University of Sheffield within the Leverhulme Centre for Climate Change Mitigation, and Lancaster University.



Balwant Singh is a Professor of Soil Science at the University of Sydney. His research interests include understanding the structural and chemical properties of soil clay minerals, adsorption reactions of trace elements at the mineral-water interface, phytoremediation of toxic elements, biochar and organic carbon interaction with soil minerals. Dr Singh is a co-author of globally popular 'Environmental Soil Chemistry' textbook; and has also co-edited two books – Biochar: A Guide to Analytical Methods and Synchrotron-based techniques in Soils and Sediments. He has been a Co-Editor-in-Chief of Soil Research journal since 2014.



Sofonyas Tefera is a PhD student in Soil Science at James Cook University. His research examines how soil conditions and management influence carbon dioxide removal through enhanced rock weathering, with a particular focus on soil pH, pCO_2, and the effects of different nitrogen fertiliser forms. He is a former soil science and agronomy researcher at Tigray Agricultural Research Institute, Ethiopia, where his work focused on soil chemistry, nutrient dynamics, and integrated soil fertility management. Mr. Sofonyas holds an MSc in Soil Science from Haramaya University, Ethiopia.



Yiwen Zhang is a PhD candidate at the Asian School of the Environment, Earth Observatory of Singapore, Nanyang Technological University, and was a visiting scholar at the University of Cambridge. Her research focuses on enhanced rock weathering (ERW) as a scalable carbon dioxide removal solution, integrating life cycle and techno-economic analysis across Southeast Asia and Australia. She examines stakeholder perspectives on durable carbon dioxide removal, with a focus on ERW, through interviews that explore deployment barriers, enabling conditions, and market readiness. With a background in environmental science and economics, her work bridges geochemical processes, carbon markets, and real-world deployment to support effective and scalable climate mitigation strategies.

Summary of Panel Discussion

A panel discussion took place at the end of symposium where symposium participants gave their opinions on carbon dioxide removal (CDR) and its measurement or monitoring, reporting and verification (MRV), adoption and scaling aspects of enhanced rock weathering (ERW) as an emerging climate change mitigation technology in Australia and New Zealand.

CDR: measurements and MRV

The participants emphasised the need for selecting or making a list of some universal or common measurement parameters for quantifying CDR via ERW across the region. Similarly, standardisation of deployment duration, gaps between measurements and use of a unanimous model would reduce discrepancy among reported CDR values. Developing some reference CDR values for soils, lakes, rivers and ocean might encourage new deployments, and linking with river and ocean alkalinity enhancement research groups would improve quantification of CDR potential. These all together would enable a strong validation of carbon capture, and potentially provide pathways for inclusion of ERW in the national carbon credit scheme.

A few research, development and extension areas that require immediate attention emerged in the discussion to enable wider adoption and scaling of ERW. These include understanding the fates of organic carbon, living or microbial carbon, cations and anions in ERW-deployed soil-plant systems, and impact on soil microbial communities under different crop, soil and climatic conditions. Participants were curious how application methods of rocks impact CDR and whether any modification of rocks boosts CDR rate. Participants pointed out the need for multidisciplinary research, combining both experimental and modelling studies, to address the above questions. Some participants thought that Australian researchers could put together a bid for a Cooperative Research Centre for conducting research, development and extension on ERW and to facilitate its widescale adoption.

Adoption

Participants wished for a speedy widescale adoption of ERW in Australia and New Zealand and recognition and incorporation of the technology in the national carbon credit scheme. Whilst incentives for farmers would encourage adoption, widespread demonstration of co-benefits, appropriate carbon accounting for large cropping systems, information on site, soil and crop- specific CDR, convenient metrics and modelling approaches, cost benefit analysis and a standard operating procedure for deployment logistics would make adoption faster. Some participants opined that integrating ERW with approaches to address soil constraints such as acidity, compaction and biodiversity loss would facilitate adoption.

Scaling

Appropriate value proposition and retail flexibility came up as important considerations for scaling ERW in diverse land management systems of Australia and New Zealand. The scaling would also depend on the regulatory landscapes of the two countries. Increased numbers of large-scale demonstration trials, effective extension and communication activities and keeping up to date about the status of adoption of ERW abroad would help to influence the regulatory frameworks in the region. Some participants thought that integrating ERW with country's blue carbon and biodiversity initiatives might be helpful for scaling the technology.