**BEFORE AN EXPERT PANEL** **FTAA-2504-1048**

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| **UNDER** | the Fast Track Approvals Act 2024 |
| **IN THE MATTER** | of a substantive application for marine consents that would otherwise be applied for under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 |
| **BY** | Trans-Tasman Resources Limited |

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# EVIDENCE OF DR SEBASTIAAN VAN DE VELDE (MARINE GEOCHEMISTRY) ON BEHALF OF TRANS-TASMAN RESOURCES LIMITED IN RESPONSE TO PART OF A REQUEST FOR INFORMATION DATED 28 NOVEMBER 2025

**3 December 2025**

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HOLM | MAJUREY

Mike Holm/Nicole Buxeda
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| Solicitor on the record | Mike Holm | [redacted] | [redacted] |
| **Contact solicitor** | Nicole Buxeda | [redacted] | [redacted] |
| **Counsel** | Morgan Slyfield | [redacted] | [redacted] |

## INTRODUCTION

### Qualifications and experience

1. My name is Dr. Sebastiaan van de Velde

2. I was awarded a Bachelor of Science by the Vrije Universiteit Brussel (Brussels, Belgium) in 2011, a Master of Science by the Vrije Universiteit Brussel (Brussels, Belgium) in 2013, and a PhD in Science jointly by the University of Antwerp and the Vrije Universiteit Brussel (Belgium) in 2018

3. I am currently a Lecturer in Marine Science at the University of Otago, and Head of the Earth Sciences New Zealand-Otago carbonate chemistry facilities. Since my PhD, I have spent 2 years as a postdoctoral fellow at the University of California, Riverside (USA) researching marine biogeochemical cycling in low oxygen oceans, and 4 years as a senior researcher in coastal carbon cycling at the Institute of Natural Sciences (Brussels, Belgium), the Free University of Brussels (Brussels, Belgium), and the University of Antwerp (Belgium). I serve as an expert on the Working Group on Fisheries Benthic Impacts and Trade-offs of the International Council for the Exploration of the Seas. I have (co-)authored 38 scientific publications, have been awarded the VLIZ North Sea Award in 2018 (for research on the Southern Bight of the North Sea), and the FWO prize for scientific climate research in 2024.

### Code of Conduct

4. I have been provided with a copy of the Code of Conduct for Expert Witnesses contained in the Environment Court's Practice Note dated 1 January 2023. I have read and agree to comply with that Code. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

**Involvement in project**

5. I have had no involvement in TTR's previous applications, and no prior involvement in the present application.

**Scope of evidence**

6. My evidence responds to the following parts of the request for information dated 28 November 2025:

> TTR submitted that any effect on the climate of releasing seabed-stored carbon or reducing carbon flux to the seabed would constitute an effect on the environment which the Panel must take into account (excluding discharges of greenhouse gases into the air). However, TTR submitted that:
>
> a. the science in this area is still developing and subject to much uncertainty and debate;
>
> b. work of the sort that might be required to quantify effects of this sort has not been done anywhere in the world other than one experimental location in the Baltic Sea (which is not comparable to the current proposal) and otherwise via a theoretical global model;
>
> c. many of the data necessary to allow even a first-order estimate of release of carbon from the proposal are lacking.
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> TTR is requested to …provide any additional information that is reasonably available to enable the Panel to assess (quantitatively or qualitatively) effects on carbon flux and seabed carbon release, including if relevant the studies referenced in (b).

**RESPONSE TO REQUEST**

7. Below is a short summary of the current scientific state-of-the-art concerning the impact of seafloor disturbances on ocean carbon sequestration, as well as a rough estimate of its potential impact.

8. The seafloor promotes carbon sequestration by (i) storage and burial of organic carbon and (ii) the production of

alkalinity[1,2]. The former (i) sequesters $CO_2$ via a biological pathway; photosynthesis in the water column fixes $CO_2$ as organic carbon, and the fraction of the organic carbon that is not remineralized back to $CO_2$ can – for practical purposes - be considered as sequestered in the sediment. The latter (ii) sequesters $CO_2$ through a physico-chemical pathway; as alkalinity in the water column increases, more atmospheric $CO_2$ can be dissolved in the water column. As a result, the production of alkalinity by sediment results in a net removal of $CO_2$ from the atmosphere. Recent research has raised concerns that anthropogenic disturbances of the seabed can influence the amount of $CO_2$ that can be sequestered by the ocean[3,4,5,6,7].

9. Disturbing the seabed induces mixing and resuspension of sediment. The resuspension and mixing will increase the

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[1] R. A. Berner, Burial of Organic Carbon and Pyrite sulfur in the modern ocean: Its geochemical and environmental significance. American Journal of Science 282, 451–473 (1982).

[2] H. Brenner, U. Braeckman, M. Le Guitton, F. J. R. Meysman, The impact of sedimentary alkalinity release on the water column CO2 system in the North Sea. Biogeosciences 13, 841–863 (2016).

[3] E. Sala, J. Mayorga, D. Bradley, R. B. Cabral, T. B. Atwood, A. Auber, W. Cheung, C. Costello, F. Ferretti, A. M. Friedlander, S. D. Gaines, C. Garilao, W. Goodell, B. S. Halpern, A. Hinson, K. Kaschner, K. Kesner-Reyes, F. Leprieur, J. McGowan, L. E. Morgan, D. Mouillot, J. Palacios-Abrantes, H. P. Possingham, K. D. Rechberger, B. Worm, J. Lubchenco, Protecting the global ocean for biodiversity, food and climate. Nature 592, 397–402 (2021).

[4] P. Khedri, O. Gourgue, J. Depestele, S. Arndt, S. J. van de Velde, Reconciling the impact of mobile bottom-contact fishing on marine organic carbon sequestration. ICES Journal of Marine Science 82

[5] W. Zhang, L. Porz, R. Yilmaz, K. Wallmann, T. Spiegel, A. Neumann, M. Holtappels, S. Kasten, J. Kuhlmann, N. Ziebarth, B. Taylor, H. Ho-Hagemann, U. Daewel, C. Schrumm, Intense and persistent bottom trawling impairs long-term carbon storage in shelf sea sediments. [Preprint] (2023). https://doi.org/10.21203/rs.3.rs-3313118/v1.

[6] S. J. van de Velde, A. Hylén, F. J. R. Meysman, Ocean alkalinity destruction by anthropogenic seafloor disturbances generates a hidden CO2 emission. Science Advances 11, eadp9112 (2025)

[7] H. T. Kalapurakkal, A. W. Dale, M. Schmidt, H. Taubner, F. Scholz, T. Spiegel, M. Fuhr, K. Wallmann, Sediment resuspension in muddy sediments enhances pyrite oxidation and carbon dioxide emissions in Kiel Bight. Commun Earth Environ 6, 1–14 (2025).

exposure of sediments to oxygen, and oxygen exposure time has been shown to stimulate the remineralization of organic carbon back to $CO_2$[8,9]. It should be noted that the drivers of organic carbon remineralization are many and complex, and depend on the type, age, and history of the organic carbon, as well as on the environment and benthic communities[10]. It is thus not trivial to quantify with confidence how much mineralization would be increased by seafloor disturbances without experimental data [4].

10. A second effect of the enhanced exposure of sediments to oxygen is the potential of pyrite reoxidation, which will reduce the amount of alkalinity the seafloor can generate[6,7]. The seafloor also generates alkalinity via calcium carbonate dissolution, for which the effect has yet to be quantified. Model simulations of dredging activities suggest that deep excavation of the seabed could lead to calcium carbonate precipitation at depth, which would reduce seafloor alkalinity generation[6].

11. Current estimates of the impact of seafloor disturbance on ocean carbon sequestration have only focused on resuspension induced by mobile bottom-contact fishing ('bottom trawling')[3,4,6,11], and—to a smaller extent—

[8] G. Hulthe, S. Hulth, P. O. J. Hall, Effect of oxygen on degradation rate of refractory and labile organic matter in continental margin sediments. Geochimica et Cosmochimica Actamica 62, 1319–1328 (1998)

[9] H. E. Hartnett, R. G. Keil, J. I. Hedges, A. H. Devol, Influence of oxygen exposure time on organic carbon preservation in continental margin sediments. Nature 391, 572–574 (1998).

[10] S. Arndt, B. B. Jørgensen, D. E. LaRowe, J. J. Middelburg, R. D. Pancost, P. Regnier, Quantifying the degradation of organic matter in marine sediments: A review and synthesis. Earth-Science Reviews 123, 53–86 (2013).

[11] W. Zhang, L. Porz, R. Yilmaz, K. Wallmann, T. Spiegel, A. Neumann, M. Holtappels, S. Kasten, J. Kuhlmann, N. Ziebarth, B. Taylor, H. T. M. Ho-Hagemann, F.-D. Bockelmann, U. Daewel, L. Bernhardt, C. Schrum, Long-term carbon storage in shelf sea sediments reduced by intensive bottom trawling. Nat. Geosci. 17, 1268–1276 (2024).

dredging[6, 12]. Bottom trawling is an activity that penetrates the seabed up to a couple of cm at most and resuspends a few mm of seabed material and is thus much less impactful (for a given area) compared to mining activity of the sort TTR proposes.

12. Current estimates of the impact of seafloor disturbance on ocean carbon sequestration come with inherent uncertainties, some of which may be quantified[(4,6,13)], and others that are unknown. Nevertheless, all studies indicate that the seafloor disturbance impacts on ocean carbon sequestration are non-trivial[14,15]. Note that the shallow water depth of TTR's proposed activities implies that any impacts on seafloor carbon sequestration will rapidly (on the timescale of a year) propagate to the atmosphere.

13. With the current available data (e.g. [16]), it is not possible to robustly assess the magnitude of the impact of the proposed sand extraction activities on ocean carbon sequestration. A better assessment of this impact would require a detailed biogeochemical characterisation of the study site prior to disturbance, experimental assessment of the impact of induced resuspension on organic carbon mineralization and

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[12] L. Porz, J. Chen, R. Yilmaz, J. Kuhlmann, W. Zhang, C. Schrum, Dreging and dumping impact coastal fluxes of sediment and organic carbon. preprint, doi:10.21203/rs.3.rs-6005877/v1

[13] J. G. Hiddink, S. J. Van De Velde, R. A. McConnaughey, E. De Borger, J. Tiano, M. J. Kaiser, A. Sweetman, M. Sciberras, Quantifying the carbon benefits of ending bottom trawling. Nature 617, E1–E2 (2023).

[14] T. B. Atwood, A. Romanou, T. DeVries, P. E. Lerner, J. S. Mayorga, D. Bradley, R. B. Cabral, G. A. Schmidt, E. Sala, Atmospheric CO2 emissions and ocean acidification from bottom-trawling. Frontiers in Marine Science 10 (2024).

[15] L. Porz, W. Zhang, N. Christiansen, J. Kossack, U. Daewel, C. Schrum, Quantification and mitigation of bottom-trawling impacts on sedimentary organic carbon stocks in the North Sea. Biogeosciences 21, 2547–2570 (2024).

[16] K. Vopel, J. Robertson, P.S. Wilson, Iron sand extraction in South Taranaki Bight: effects on seawater trace metal concentrations. AUT Client Report: TTRL 20138. August 2013

seafloor alkalinity generation, and ideally the development of a seafloor model to allow estimation of longer-term effects and effects of repeated or ongoing disturbances.

**Sebastiaan van de Velde**

3 December 2025