ANNUAL REPORT ON GEOTRACES ACTIVITIES IN SWITZERLAND

May 1st, 2021 to April 30th, 2022

New GEOTRACES or GEOTRACES-relevant scientific results (highlights)

- An updated view of the marine Cr cycle: Observational work led by Dr. David Janssen combined incubation experiments, water-column, bottom-water, pore-water and sediment sampling with literature data to update our view of the global marine biogeochemical cycle of Cr (Janssen et al., 2021, *Earth and Planetary Science Letters*). This work was complemented by a modelling study into the first-order controls on the marine Cr cycle (Pöppelmeier et al., 2021, *Biogeosciences*).
- A re-assessment of controls on the marine Cd cycle: A review article led by researchers at ETH Zurich critically assessed the evidence in water-column and particulate data for the proposed loss of dissolved Cd to particle-associated sulphide formation, and found that stoichiometric variability in biological Cd uptake is in fact the major driver of trends observed in the marine Cd-PO_4 relationship (de Souza et al., 2022, *Geochimica et Cosmochimica Acta*).

GEOTRACES or GEOTRACES-relevant cruises

- Doctoral student Delphine Gilliard (University of Lausanne, supervised by Prof. S. L. Jaccard & Dr. D. J. Janssen) participated in *FS Meteor* cruise M176-2 to collect samples for analysis of seawater Cr isotopes (δ^{53}Cr); she will also analyse samples collected on *FS Sonne* cruise SR289.
- Prof. S. L. Jaccard participated in the Arctic Century Expedition to the Russian Arctic (Barents, Laptev and Kara Seas) in August/September 2021, funded by the Swiss Polar Institute and partner organisations.
- Prof. D. Vance collaborated with the Max Planck Institut für Chemie (MPIC) Mainz to collect seawater samples on S/V *Eugen Seibold* cruise ES22C01 (February 2022, eastern tropical Atlantic) for analysis of Ni concentration and isotopes at ETH Zurich.

New projects and/or funding

- Prof. S. L. Jaccard is involved in the project "GreenFjord – Greenlandic Fjord ecosystems in a changing climate: socio-cultural and environmental interactions" funded by the Swiss Polar Institute Flagship Initiative. **CHF 1,500k**.

GEOTRACES workshops and meetings organized

- Dr. D. J. Janssen co-convened a session at Ocean Sciences Meeting 2022 (Hawai'i and virtual) entitled "Sources, sinks and cycling of trace elements in coastal and near-shore systems".

Outreach activities conducted

- Prof. S. L. Jaccard participated in creating materials for Swiss Polar Class, an educational outreach programme (in German and French) for school-going students (ages 8-12). These can be found at https://polar-class.ch/de/arctic-century-expedition/

New GEOTRACES or GEOTRACES-relevant publications *(Researchers at Swiss institutions in bold)*

Brzezinski, M. A., I. Closset, J. L. Jones, **G. F. de Souza**, **C. Maden** (2022). New constraints on the physical and biological controls on the silicon isotopic composition of the Arctic Ocean. *Frontiers in Marine Science* 8, Article 699762.

de Souza, G. F., **D. Vance**, M. Sieber, T. M. Conway and S. H. Little (2022). Re-assessing the influence of particle-hosted sulphide formation on the marine cadmium cycle. *Geochimica et Cosmochimica Acta* 322, 274-296. *Invited review article.*

Farmer, J. R., J. E. Hertzberg, D. Cardinal, S. Fietz, K. Hendry, **S. L. Jaccard**, A. Paytan, P. A. Rafter, H. Ren, C. J. Somes, J. N. Sutton, GEOTRACES–PAGES Biological Productivity Working Group Members (2021). Assessment of C, N and Si isotopes as tracers of past ocean nutrient and carbon cycling. *Global Biogeochemical Cycles* 35, doi: 10.1029/2020GB006775.

Giesbrecht, K. E., D. E. Varela, **G. F. de Souza**, **C. Maden** (2022). Natural variations in dissolved silicon isotopes across the Arctic Ocean from the Pacific to the Atlantic. *Global Biogeochemical Cycles* 36, doi: 10.1029/2021GB007107.

Hayes, C. T. and 28 co-authors including **S. L. Jaccard** (2021). Global ocean sediment composition and burial flux in the deep sea. *Global Biogeochemical Cycles* 35, doi: 10.1029/2020GB006769.

He, Z., **M. O. Clarkson**, M. B. Andersen, **C. Archer**, **T. C. Sweere**, P. Kraal, **A. Guthauser**, F. Huang, **D. Vance** (2021). Temporally and spatially dynamic redox conditions on an upwelling margin: the impact on coupled sedimentary Mo and U isotope systematics, and implications for the Mo-U paleoredox proxy. *Geochimica et Cosmochimica Acta* 309, 251-271.

Horner, T. J., S. H. Little, T. M. Conway, J. R. Farmer, J. E. Hertzberg, **D. J. Janssen**, A. J. M. Lough, J. McKay, A. Tessin, S. J. G. Galer, **S. L. Jaccard**, F. Lacan, A. Paytan, K. Wuttig, GEOTRACES–PAGES Biological Productivity Working Group Members (2021). Bioactive trace metals and their isotopes as paleoproductivity proxies: An assessment using GEOTRACES-era data. *Global Biogeochemical Cycles* 35, Article 2020GB006814.

Janssen, D. J., **J. Rickli**, A. N. Abbott, M. J. Ellwod, B. S. Twining, D. C. Ohnemus, **P. Nasemann**, **D. Gilliard**, **S. L. Jaccard** (2021). Release from biogenic particles, benthic fluxes, and deep water circulation control Cr and δ^{53}Cr distributions in the ocean interior. *Earth and Planetary Science Letters* 574, Article 117163.

Kurzweil, F., **C. Archer**, M. Wille, R. Schoenberg, C. Münker, O. Dellwig (2021). Redox control on the tungsten isotope composition of seawater. *PNAS* 118, Article 2023544118.

Lemaitre, N., **J. Du**, **G. F. de Souza**, **C. Archer**, **D. Vance** (2022). The essential bioactive role of nickel in the oceans: evidence from nickel isotopes. *Earth and Planetary Science Letters* 584, Article 117513, doi: 10.1016/j.epsl.2022.117513.

Nixon, R. L., M. A. Peña, R. Taves, **D. J. Janssen**, J. T. Cullen, A. R. Ross (2021). Evidence for the production of copper-complexing ligands by marine phytoplankton in the subarctic northeast Pacific. *Marine Chemistry* 237, Article 104034.

Pöppelmeier, F., **D. J. Janssen**, **S. L. Jaccard**, **T. F. Stocker** (2021). Modeling the marine chromium cycle: New constraints on global-scale processes. *Biogeosciences* 18, 5447–5463.

Revels, B. N., **J. Rickli**, C. A. V. Moura, **D. Vance** (2021). Nickel and its isotopes in the Amazon Basin: The impact of the weathering regime and delivery to the oceans. *Geochimica et Cosmochimica Acta* 293, 344-364.

Schwab, M. S., **J. D. Rickli**, R. W. Macdonald, H. R. Harvey, **N. Haghipour**, **T. I. Eglinton** (2021). Detrital neodymium and (radio)carbon as complementary sedimentary bedfellows? The Western Arctic Ocean as a testbed. *Geochimica et Cosmochimica Acta* 315, 101-126.

Sherwood, O. A., S. H. Davin, N. Lehmann, C. Buchwald, E. N. Edinger, **M. F. Lehmann**, M. Kienast (2021). Stable isotope ratios in seawater nitrate reflect the influence of Pacific water along the northwest Atlantic margin. *Biogeosciences* 18, 4491-4510.

Sieber, M., T. M. Conway, **G. F. de Souza**, C. S. Hassler, M. J. Ellwood, **D. Vance** (2021). Isotopic fingerprinting of biogeochemical processes and iron sources in the iron-limited surface Southern Ocean. *Earth and Planetary Science Letters* 567, Article 116967.

Taves, R. C., **D. J. Janssen**, M. A. Peña, A. R. S. Ross, K. G. Simpson, W. R. Crawford, J. T. Cullen (2022). Relationship between surface dissolved iron inventories and net community production during a marine heatwave in the subarctic northeast Pacific. *Environmental Science: Processes and Impacts*, doi: 10.1039/D2EM00021K.

Completed GEOTRACES PhD or Master theses

- Delphine Gilliard (2021). Dissolved chromium concentration and δ^{53}Cr: a tool to quantify the strength of the biological pump in the South Pacific Ocean. *M.Sc. thesis, University of Bern.*

GEOTRACES presentations in international conferences *(Researchers at Swiss institutions in bold)*

Conway, T. M., J. B. Palter and **G. F. de Souza** (2021). Gulf Stream eddies as an important transfer of high-Fe slope water across the Gulf Stream into the North Atlantic Subtropical Gyre. *Poster presentation at the International Workshop on Western Boundary Current-Subtropical Continental Shelf Interactions (Savannah GA, USA)*.

Deng, K., J. Du, J. Rickli, T. J. Suhrhoff, D. Vance (2021). Preconcentration and determination of beryllium and rare earth elements in small volumes of marine pore-water. *Poster presentation at the 2021 Goldschmidt Conference (virtual).*

de Souza, G. F., **D. Vance**, M. Sieber, T. M. Conway, S. H. Little (2021). Re-assessing the role of water-column sulphide formation in the marine Cd cycle. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

Du, J., B. A. Haley, A. C. Mix, **D. Vance** (2021). Studying the cycles of trace elements and isotopes at the sediment-water interface using a diagenetic model with automatic code generation for user defined problems. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

Eisenring, C., **G. F. de Souza**, S. E. Oliver, S. Khatiwala, **D. Vance** (2021). The potential of GEOTRACES Zn data for constraining biogeochemical model behaviour. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

Fleischmann, S., **A. Chatterjee**, J. McManus, **D. Vance** (2021). The oceanic budget of nickel: new concentration and isotope data from Mn-rich pelagic sediments. *Poster presentation at the 2021 Goldschmidt Conference (virtual).*

Janssen, D.J., **J. Rickli**, M. Wille, **C. S. Hassler**, H. Vogel, **S. L. Jaccard** (2022). Chromium cycling in euxinic basins: Implications for the δ^{53}Cr paleoredox proxy from modern systems. *Oral presentation at the 2022 Ocean Sciences Meeting (Hawai'i and virtual).*

Janssen, D.J., **J. Rickli**, A. N. Abbott, M. J. Ellwood, P. Nasemann, B. S. Twining, D. C. Ohnemus, D. **Gilliard**, **S. L. Jaccard** (2021). Elucidating biogenic components of the

δ^{53}Cr cycle in the modern ocean. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

Lemaitre, N., **C. Archer**, **G. F. de Souza**, **J. Du**, **D. Vance** (2021). The oceanic biogeochemistry of nickel and its isotopes. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

Pöppelmeier, F., D. J. Janssen, S. L. Jaccard, T. F. Stocker (2021). Modeling the marine chromium cycle with an EMIC: constraining global-scale processes. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

Sweere, T., K. A. Ungerhofer, **N. Lemaitre**, P. Kraal, **D. Vance** (2021). Nickel-isotope cycling on the Namibian margin. *Oral presentation at the 2021 Goldschmidt Conference (virtual).*

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