

Studies

- 1988-1994
Studied biology (and chemistry) at Carl von Ossietzky University Oldenburg and Rheinische Friedrich-Wilhelms-Universität Bonn
- 1993-1994
Diploma thesis (Botanical Cytology at the University of Bonn)
"Immunocytological investigations of plasma membrane H⁺-ATPase along the membrane flow route using Brefeldin A"
(Supervisor: Prof. Volkmann)
- 1994-1998
Doctoral thesis at the University of Osnabrück (Animal Physiology)
"Modifications of the behaviour and electrical properties of *Euplotes vannus* and *Euplotes raikovi* by food signals and sexual stimuli"
(Supervisors: Prof. Lueken and Priv.-Doz. Krüppel)
- 1998-2002
Postdoc at the University of Hawai'i at Manoa, Pacific Biomedical Research Centre and Department of Microbiology
(Mentors: Prof. R.D. Allen and Prof. Y. Naitoh)
- 2008
Venia legendi for the subject of physiology, awarded by the Medical Faculty of the University of Münster
Topic of the habilitation thesis: "How ion translocation across the plasma membrane modulates cell motility"
(Mentor: Prof. Schwab)
- 2014
Adjunct professorship, awarded by the Faculty of Medicine of the University of Münster
- 2017
Recognition to use the title 'Fachphysiologe' (specialist physiologist), granted by the German Physiological Society
- 2017
Rehabilitation at the MHH with recognition of the adjunct professorship

Professional career

- 1994-1998
Doctoral student in animal physiology at the University of Osnabrück as a member of the research-training group 'Molecular Cell Biology with a Focus on Membrane Biology'
- 1998
Visiting scientist at the research training group 'Molecular Cell Biology with a Focus on Membrane Biology' at the University of Osnabrück
- 1998
Research assistant in cell biology at Heidelberg University
- 1998-2002
Postdoctoral fellow at the University of Hawai'i at Manoa, Pacific Biomedical Research Centre and Department of Microbiology, as a DAAD and NSF scholarship holder
- 2002-2003
Research assistant at the Institute of Physiology at Julius Maximilian University of Würzburg
- 2003-2014
Research assistant at the Institute of Physiology II at the University Hospital of the University of Münster
- September 2014-present
Member of the Seidler Research Group

Publications

2025

Wang, J., **Stock, C.**, Salari, A., Seidler U.E., Nikolovska K. (2025) Sodium/hydrogen exchanger 8 affects sheet migration of human intestinal epithelial cells (HT29MTX) by influencing the actin cytoskeletal rearrangement. *Am. J. Physiol. - Cell Physiol.* **329**, C50-C67.

2024

Jiang, M., Salari, A., **Stock, C.**, Nikolovska, K., Boedtkjer, E., Amiri, M., Seidler, U. (2024). The electroneutral $\text{Na}^+/\text{HCO}_3^-$ cotransporter NBCn1 (SLC4A7) modulates colonic enterocyte pH_i , proliferation and migration. *Am. J. Physiol. - Cell Physiol.* **326**, C1625-C1636.

Stock, C. (2024). pH-regulated single cell migration. *Pflügers Archiv – Eur. J. Physiol.* **476**, 639-658.

2022

Becker, Y., **Stock, C.** (2022). The ACE inhibitor lisinopril stimulates melanoma cell invasiveness by inducing MMP2 secretion. *Cell. Physiol. Biochem.* **56**, 457-483.

Stock, C. (2022). Circulating tumor cells: Does ion transport contribute to intravascular survival, adhesion, extravasation and metastatic organotropism? *Rev. Physiol. Biochem. Pharmacol.* **182**, 139-175.

Nikolovska, K., Seidler, U.E., **Stock, C.** (2022). The role of plasma membrane sodium/hydrogen exchangers in gastrointestinal functions: proliferation and differentiation, fluid/electrolyte transport and barrier integrity. *Front. Physiol.* **13**, 899286.

2021

Stock, C. (2021). How dysregulated ion channels and transporters take a hand in esophageal, liver and colorectal cancer. *Rev. Physiol. Biochem. Pharmacol.* **181**, 129-222.

2020

Flinck, M., Hagelund, S., Gorbatenko, A., Severin, M., Pedraz-Cuesta, E., Novak, I., **Stock, C.**, Pedersen, S.F. (2020). The Vacuolar H^+ ATPase $\alpha 3$ subunit negatively regulates migration and invasion of human pancreatic ductal adenocarcinoma cells. *Cells* **9**, 465.

Cao, L., Yuan, Z., Liu, M., **Stock, C.** (2020). (Patho-)Physiology of Na^+/H^+ exchangers (NHEs) in the digestive system. *Front. Physiol.* **10**, 1566.

2019

Keurhorst, D., Liashkovich, I., Frontzek, F., Nitzlaff, S., Dreier, R., **Stock, C.** (2019). MMP3-activity rather than cortical stiffness determines NHE1-dependent invasiveness of melanoma cells. *Cancer Cell Int.* **19**, 285.

2018

Olschewski, D.N., Hofschröer, V., Nielsen, N., Seidler, D.G., Schwab, A., **Stock, C.** (2018). The angiotensin II type 1 receptor antagonist Losartan affects NHE1-dependent melanoma cell behavior. *Cell. Physiol. Biochem.* **45**, 2560-2576.

2017

Nikolovska, K., Spillmann, D., Haier, J., Ladányi, A., **Stock, C.**, Seidler, D.G. (2017). Melanoma cell adhesion and migration is modulated by the Uronyl 2-O Sulfotransferase. *PLoS ONE* **12**, e0170054.

Viola, M., Brüggemann, K., Karousou, E., Caon, I., Caravà, E., Vigetti, D., Greve, B., **Stock, C.**, De Luca, G., Passi, A., Götte, M. (2017). MDA-MB-231 breast cancer cell viability, motility and matrix adhesion are regulated by a complex interplay of heparan sulfate, chondroitin-/dermatan sulfate and hyaluronan biosynthesis. *Glycoconj. J.* **34**, 411-420.

Hofschröer, V., Koch, K.A., Ludwig, F.T., Friedl, P., Oberleithner, H., **Stock C.***, Schwab, A.* (2017). Extracellular protonation modulates cell-cell interaction mechanics and tissue invasion in human melanoma cells. *Sci. Rep.* **7**, 42369. *co-corresponding authors

Stock, C., Pedersen, S.F. (2017). Roles of pH and the Na⁺/H⁺ exchanger NHE1 in cancer: From cell biology and animal models to an emerging translational perspective? *Sem. Cancer Biol.* **43**, 5-16.

Seidler, D.G., **Stock, C.** (2017). Zuckerverbindungen zur unterstützenden Behandlung des metastasierenden Melanoms? *Journal Onkologie Ausgabe 3/2017*, 203-207.

2016

Franz, J., Brinkmann, B.F., König, M., Hüve, J., **Stock, C.**, Ebnet, K., Riethmüller, C. (2016). Nanoscale imaging reveals a tetraspanin-CD9 coordinated elevation of endothelial ICAM-1 clusters. *PLoS ONE* **11**, e0146598.

Riemann, A., Schneider, B., Gündel, D., **Stock, C.**, Gekle, M., Thews, O. (2016). Acidosis promotes metastasis formation by enhancing tumor cell motility. *Adv. Exp. Med. Biol.* **876**, 215-220.

2015

Schwickert, A., Weghake, E., Brüggemann, K., Engbers, A., Brinkmann, B.F., Kemper, B., Seggewiß, J., **Stock, C.**, Ebnet, K., Kiesel, L., Riethmüller, C., Götte, M. (2015). microRNA miR-

142-3p inhibits breast cancer cell invasiveness by synchronous targeting of WASL, integrin α_v , and additional cytoskeletal elements. *PLoS ONE* **10**, e0143993.

Spugnigni, E., Sonveaux, P., **Stock, C.**, Perez-Sayans, M., De Mito, A., Avnet, S., García García, A., Harguindey, S., Fais, S. (2015). Implication of proton channels and exchangers in cancer. *Biochim. Biophys. Acta* **1848**, 2715-2726.

Stock, C., Schwab, A. (2015). Ion channels and transporters in metastasis. *Biochim. Biophys. Acta* **1848**, 2638-2646.

Alfarouk, K.O., **Stock, C.M.**, Taylor, S., Walsh, M., Muddathir, A.K., Verduzco, D., Bashir, A.H., Mohammed, O.Y., Elhassan, G.O., Harguindey, S., Reshkin, S.J., Ibrahim, M.E., Rauch, C. (2015). Resistance to cancer therapy: failure in drug response from ADME to P-gp. *Cancer Cell Int.* **15**, 71.

2014

Vahle, A.-K., Domikowsky, B., Schwöppe, C., Krähling, H., Mally, S., Schäfers, M., Hermann, S., Shahin, V., Haier, J., Schwab, A., **Stock, C.** (2014). Extracellular matrix composition and interstitial pH modulate NHE1-mediated melanoma cell motility. *Int. J. Oncol.* **44**, 78-90.

Riemann, A., Schneider, B., Gündel, D., **Stock, C.**, Thews, O., Gekle, M. (2014). Acidic priming enhances metastatic potential of cancer cells. *Eur. J. Physiol.* **466**, 2127-2138.

Kumar, A.V., Salem Gassar, E., Spillmann, D., **Stock, C.**, Sen, Y.P., Zhang, T., Van Kuppevelt, T.H., Hülsewig, C., Koszowski, E., Pavao, M.S., Ibrahim, S.A., Poeter, M., Rescher, U., Kiesel, L., Koduru, S., Yip, G.W., Götte, M. (2014). HS3ST2 modulates breast cancer cell invasiveness via MAP kinase- and Tcf4 (Tcf7l2)-dependent regulation of protease and cadherin expression. *Int. J. Cancer* **135**, 2579-2592.

Lindner, K., Borchardt, C., Schöpp, M., Bürgers, A., **Stock, C.**, Hussey, D.J., Haier, J., Hummel, R. (2014). Proton pump inhibitors (PPIs) impact on tumour cell survival, metastatic potential and chemotherapy resistance, and affect expression of resistance-relevant miRNAs in esophageal cancer. *J. Exp. Clin. Cancer Res.* **33**, 73.

Frontzek, F., Nitzlaff, S., Horstmann, M., Schwab, A., **Stock, C.** (2014). Functional interdependence of NHE1 and merlin in human melanoma cells. *Biochem. Cell Biol.* **92**, 430-540.

Schwab, A. and **Stock, C.** (2014). Ion channels and transporters in tumour cell migration and invasion. *Philosophical Transactions of the Royal Society B*, **369**, 1638.

2013

Ludwig, F.T., Schwab, A., **Stock, C.** (2013). The Na^+/H^+ exchanger (NHE1) generates pH nanodomains at focal adhesions. *J. Cell. Physiol.* **228**, 1351-1358.

Di Marco, G.S., König, M., **Stock, C.**, Wiesinger, A., Hillebrand, U., Reiermann, S., Reuter, S., Amler, S., Köhler, G., Buck, F., Fobker, M., Kümpers, P., Oberleithner, H., Hausberg, M., Lang,

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Clement, D. L., Mally, S., **Stock, C.**, Lethan, M., Satir, P., Schwab, A., Pedersen S.F., Christensen, S.T. (2013). PDGFR α signaling in the primary cilium regulates NHE1-dependent fibroblast migration via coordinated differential activity of MEK1/2-ERK1/2-p90^{RSK} and AKT signaling pathways. *J. Cell Sci.* **126**, 953-965.

Van Horssen, R., Willemse, M., Haeger, A., Attanasio, F., Günen, T., Schwab, A., **Stock, C.**, Buccione, R., Franssen, J.A.M., Wieringa, B. (2013). Intracellular NAD(H) levels control motility and invasion of glioma cells. *Cell Mol. Life Sci.* **70**, 2175-2190.

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Pedersen S.F. and **Stock C.** (2013). Ion channels and transporters in cancer: pathophysiology, regulation and clinical potential. Meeting Report. *Cancer Res.* **73**, 1-4.

2012

Schwab, A., Nechyporuk-Zloy, V., Gassner, B., Schulz, C., Kessler, W., Mally, S., Römer, M., **Stock, C.** (2012). Dynamic redistribution of calcium sensitive potassium channels (hKCa3.1) in migrating cells. *J. Cell. Physiol.* **227**, 686-696.

Lauritzen, G., **Stock, C.**, Lemaire, J., Lund, S.F., Jensen, M.F., Damsgaard, B., Petersen, K.S., Wiwel, M., Rønnov-Jessen, L., Schwab A., Pedersen, S.F. (2012). The Na⁺/H⁺ exchanger NHE1, but not the Na⁺,HCO₃⁻ cotransporter NBCn1, regulates motility of MCF7 breast cancer cells expressing constitutively active ErbB2. *Cancer Letters* **317**, 172-183.

Ibrahim, S.A., Yip, G.W., **Stock, C.**, Pan, J.-W., Neubauer, C., Poeter, M., Pupjalis, D., Koo, C.Y., Kelsch, R., Schüle, R., Rescher, U., Kiesel, L., Götte, M. (2012). Targeting of Syndecan-1 by microRNA miR-10b promotes breast cancer cell motility and invasiveness via a Rho-GTPase- and E-cadherin-dependent mechanism. *Int. J. Cancer* **131**, E884-E896.

Jungmann, O., Nikolovska, K., **Stock, C.**, Schulz, J.-N., Eckes, B., Riethmüller, C., Owens, R.T., Iozzo, R.V., Seidler, D.G. (2012). The dermatan sulfate proteoglycan decorin modulates $\alpha 2\beta 1$ integrin and the vimentin intermediate filament system in a collagen-rich matrix. *PLoS ONE* **7**, e50809.

Stock, C., Ludwig, F.T., Schwab, A. (2012). Is the multifunctional Na⁺/H⁺ exchanger isoform 1 a potential therapeutic target in cancer? *Curr. Med. Chem.* **19**, 647-660.

Schwab, A., Fabian, A., Hanley, P.J., **Stock, C.** (2012). Role of ion channels and transporters in cell migration. *Physiol. Rev.* **92**, 1865-1913.

2011

Martin, C., Pedersen, S.F., Schwab, A., **Stock, C.** (2011). Intracellular pH gradients in migrating cells. *Am. J. Physiol.* **300**, C490-C495.

Stock, C., Jungmann, O., Seidler, D.G. (2011). Decorin and chondroitin-6 sulfate inhibit B16V melanoma cell migration and invasion by cellular acidification. *J. Cell. Physiol.* **226**, 2641-2650.

Stock, C., Riethmüller, C. (2011). Endothelial activation drives lateral migration and diapedesis of leukocytes. *Cell. Immunol.* **271**, 180-183.

2010

Schneider, L., Cammer, M., Lehman, J., Nielsen, S.K., Guerra, C.F., Veland, I.R., **Stock, C.,** Hoffmann, E.K., Yoder, B.K., Schwab, A., Satir, P., Christensen, S.T. (2010). Directional cell migration and chemotaxis in wound healing response to PDGF-AA are coordinated by the primary cilium in fibroblasts. *Cell. Physiol. Biochem.* **25**, 279-292.

Götte, M., Mohr, C., Koo, C.-Y., **Stock, C.,** Vaske, A.-K., Viola, M., Ibrahim, S.A., Peddibhotla, S., Teng, Y. H.-F., Low, J.-Y., Ebnet, K., Kiesel, L., Yip, G.W. (2010). miR-145-dependent targeting of junctional adhesion molecule A and modulation of fascin expression are associated with reduced breast cancer cell motility and invasiveness. *Oncogene* **29**, 6569-6580.

2009

Hillebrand, U., Lang, D., Telgmann, R.G., Hagedorn, C., Reuter, S., Kliche, K., **Stock, C.,** Oberleithner, H., Pavenstädt, H., Büsselmeier, E., Hausberg, M. (2009). Nebivolol decreases endothelial cell stiffness via the estrogen receptor beta: a nano-imaging study. *J. Hypertens.* **27**, 517-526.

Schneider, L., **Stock, C.,** Dieterich, P., Satir, P., Schwab, A., Christensen, S.T., Pedersen, S.F. (2009). The Na⁺/H⁺ exchanger NHE1 plays a central role in directional migration stimulated via PDGFRα in the primary cilium. *J. Cell Biol.* **185**, 163-176.

Callies, C., Schön, P., Liashkovich, I., **Stock, C.,** Kusche-Vihrog, K., Fels, J., Sträter, A.S., Oberleithner, H. (2009). Simultaneous mechanical stiffness and electrical potential measurements of living vascular endothelial cells using combined atomic force and epifluorescence microscopy. *Nanotechnology* **20**, 175104.

Krähling, H., Mally, S., Eble, J.A., Noël, J., Schwab, A., **Stock, C.** (2009). The glycocalyx maintains a cell surface pH nanoenvironment crucial for integrin-mediated migration of human melanoma cells. *Eur. J. Physiol.* **458**, 1069-1083.

Stock, C. and Schwab, A. (2009). Protons make tumor cells move like clockwork. *Eur. J. Physiol.* **458**, 981-992.

2008

Schneider, L., Klausen, T., **Stock, C.,** Mally, S., Christensen, S., Pedersen, S., Hoffmann, E., Schwab, A. (2008). H-ras transformation sensitizes volume-activated anion channels and increases migratory activity of NIH3T3 fibroblasts. *Eur. J. Physiol.* **455**, 1055-1062.

Nechyporuk-Zloy, V., Dieterich, P., Oberleithner, H., **Stock, C.**, Schwab, A. (2008). Dynamics of single potassium channel proteins in the plasma membrane of migrating cells. *Am. J. Physiol.* **294**, C1096-1102.

Hillebrand, U., Hausberg, M., Lang, D., **Stock, C.**, Riethmüller, C., Callies, C., Büsse-maker, E. (2008). How steroid hormones act on the endothelium-insights by atomic force microscopy. *Eur. J. Physiol.* **456**, 51-60.

Stock, C., Cardone, R.A., Busco, G., Krähling, H., Schwab, A., Reshkin, S.J. (2008). Protons extruded by NHE1: Digestive or glue? *Eur. J. Cell Biol.* **87**, 591-599.

Schwab, A., Hanley, P., Fabian, A., **Stock, C.** (2008). Potassium channels keep mobile cells on the go. *Physiology* **23**, 212-220.

2007

Hillebrand, U., Schillers, H., Riethmüller, C., **Stock, C.**, Wilhelmi, M., Oberleithner, H. and Hausberg, M. (2007). Dose-dependent endothelial cell growth and stiffening by aldosterone: endothelial protection by eplerenone. *J. Hypertens.* **25**, 639-647.

Stock, C., Mueller, M., Kraehling, H., Mally, S., Noël, J., Eder, C., Schwab, A. (2007). pH nanoenvironment at the surface of single melanoma cells. *Cell. Physiol. Biochem.* **20**, 679-686.

Stüwe, L., Müller, M., Fabian, A., Waning, J., Mally, S., Noël, J., Schwab, A., **Stock, C.** (2007). pH dependence of melanoma cell migration: Protons extruded by NHE1 dominate protons of the bulk solution. *J. Physiol.* **585**, 351-360.

Schwab, A., Nechyporuk-Zloy, V., Fabian, A. and **Stock, C.** (2007). Cells move when ions and water flow. *Eur. J. Physiol.* **453**, 421-432.

2006

Schwab, A., Wulf, A., Schulz, C., Kessler, W., Nechyporuk-Zloy, V., Römer M., Reinhardt J., Weinhold, D., Dieterich, P., **Stock, C.**, and Hebert, S.C. (2006). Subcellular distribution of calcium-sensitive potassium channels (IK1) in migrating cells. *J. Cell. Physiol.* **206**, 86-94.

Hillebrand, U., Hausberg, M., **Stock, C.**, Shahin, V., Nikova, D., Riethmüller, C., Kliche, K., Ludwig, T., Schillers, H., Schneider, S.W., and Oberleithner H. (2006). 17 β -estradiol increases volume, apical surface and elasticity of human endothelium mediated by Na⁺/H⁺ exchange. *Cardiovasc. Res.* **69**, 916-924.

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Stock, C., Schilling, T., Schwab, A., and Eder, C. (2006). Lysophosphatidylcholine stimulates IL-1 β release from microglia via a P2X₇ receptor-independent mechanism. *J. Immunol.* **177**, 8560-8568.

Stock, C. and Schwab, A. (2006). The role of the Na⁺/H⁺ exchanger NHE1 in cell migration. *Acta Physiol.* **187**, 149-157.

Stock, C. and Schwab, A. (2006). How ion channels and transporters affect metastasis. *PN (Physiology News, Quarterly Newsletter of the Physiological Society, UK)*, spring edition, number 62, 19-20.

2005

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1997-2004

Schilling, T., **Stock, C.**, Schwab, A., and Eder, C. (2004). Functional importance of Ca²⁺-activated K⁺ channels for lysophosphatidic acid-induced microglial migration. *Eur. J. Neurosci.* **19**, 1469-1474.

Stock, C., Grønlien, H.K., Allen, R.D., and Naitoh, Y. (2002). Osmoregulation in *Paramecium*: in situ ion gradients permit water to cascade through the cytosol to the contractile vacuole. *J. Cell Sci.* **115**, 2339-2348.

Grønlien, H.K., **Stock, C.**, Aihara, M.S., Allen, R.D. and Naitoh, Y. (2002). Relationship between the membrane potential of the contractile vacuole complex and its osmoregulatory activity in *Paramecium multimicronucleatum*. *J. Exp. Biol.* **205**, 3261-3270.

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