

Anouk Margaretha Borst, PhD, MSc, BSc

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EMPLOYMENT

2016-current	Postdoctoral Research Fellow UNIVERSITY OF ST ANDREWS, SCOTLAND UK SOSRARE consortium funded by NERC, GCRF funding for Angola. PI: Prof Adrian Finch Mineralogical studies of REE-Zr-Nb-U-Th deposits in Greenland, China, Angola and Madagascar using synchrotron x-ray absorption, Lu-Hf, Sm-Nd and U-Pb isotope geochemistry, petrography and mineral chemistry
2012-2016	PhD Researcher GEOLOGICAL SURVEY OF DENMARK AND GREENLAND, COPENHAGEN, DENMARK Petrology and mineralogy of layered alkaline intrusion in Greenland, including mineral chemistry (EMPA), isotope geochemistry (TIMS, ICPMS)
OCT 2015	Invited Researcher GREENLAND INSTITUTE FOR NATURAL RESOURCES, NUUK, GREENLAND
2014-2015	Visiting Researcher , NATURAL HISTORY MUSEUM OSLO and UNIVERSITY OF OSLO, NORWAY XRD, SEM and EMPA analyses for PhD research. Collaboration with Prof Henrik Friis
2006-2012	Recruiter, Teaching- and Lab-assistant VU UNIVERSITY AMSTERDAM, THE NETHERLANDS
2009	EuroGeoMars Crew 76 geologist MARS DESERT RESEARCH STATION, MARS SOCIETY, UTAH USA Crew geologist/Health and Safety Officer in Crew 76. Responsible for acquisition, deployment and testing of geological instruments designed for planetary exploration by ESA and NASA.
2008-2009	Research internship EUROPEAN SPACE AGENCY (ESA-ESTEC), NOORDWIJK, THE NETHERLANDS 6 month research project on lunar geology and planetary exploration

EDUCATION

2012-2016	Doctor of Philosophy , UNIVERSITY OF COPENHAGEN, based at GEOLOGICAL SURVEY OF DENMARK AND GREENLAND, COPENHAGEN, DENMARK Funded by Geocenter Denmark. Advisors: Prof Tod Waight, Dr Henrik Friis and Dr Troels Nielsen <ul style="list-style-type: none"> Thesis: <i>'Mineralogy and Geochemistry of REE, Zr, Nb mineralised nepheline syenites in the peralkaline Ilimaussaq Complex, South Greenland'</i>
2009-2012	Master of Science, Solid Earth (Cum Laude) VU UNIVERSITY AMSTERDAM, THE NETHERLANDS Advisor: Prof Gareth Davies <ul style="list-style-type: none"> Thesis: <i>'Formation and modification of the sub-cratonic lithospheric mantle beneath Botswana: A petrological, geochemical and isotopic study of mantle xenoliths from the Letlhakane kimberlite.'</i>
2005-2009	Bachelor of Science, Earth Sciences (High Merit) VU UNIVERSITY AMSTERDAM, THE NETHERLANDS Advisors: Prof Gareth Davies, Prof Wim van Westrenen and Prof Bernard Foing <ul style="list-style-type: none"> Thesis: <i>'Geological and geochemical analysis of the lunar South Pole – Aitken Basin'</i>

GRANTS & AWARDS

2019	Global Challenges Research Fund: 'The Economic Potential of Green Technology Metals in Angola'. Knowledge exchange and field-campaign to explore alkaline igneous complexes in Angola (£19.124)
2017	NERC Facility grant for CA-ID-TIMS U-Pb analyses at NIGL Keyworth (£99.000)
2016	Diamond Light Source: 3 days I18 beamtime for XANES/EXAFS studies of REE-minerals (eq. to £30.000) KIT Karlsruhe Light Source: 5 days SUL-X joint beamtime with Dr Platon Gamaletsos (eq. to £30.000)
2012-2015	GeoCenter Denmark: PhD scholarship and fieldwork, with additional support from MIMA & GEUS (€240.000) SAFT Society for Arctic Research: Analytical/travel grant to the University of Oslo and Natural History Museum of Oslo (€750)
2015	DGF Annual Meeting: Best PhD Poster Award
2014	NordMin: Travel grant for NordMin PhD course Sustainable Mining at Luleå University, Sweden (€500)
2009	International Lunar Exploration Working Group: Financial support for EuroGeoMars Field Campaign
2008	ESRON: Travel grant for participation in ESA/FFG Summerschool Alpbach, Austria (€250)

PUBLICATIONS

Borst, A.M., Finch, A.A. Horsburgh, N.J.H. Friis, H., Gamaletsos, P.N., Goettlicher, J., Steiniger, R., Geraki, K. *Mineralogical Magazine* (Accepted) Structural State of Heavy Rare Earths in Eudialyte-hosted Critical Metal Deposits.

- Hutchison, W., Babiak, R. J., Finch, A. A., Marks, M. A. W., Markl, G., Boyce, A. J., Stueeken, E. E., Friis, H., **Borst A.M.**, Horsburgh, N. J., *Nature Communications* (Accepted), Sulphur isotopes of alkaline magmas support deep recycling of Earth's crust.
- Van de Ven, M., **Borst, A.M.**, Davies, G.R, Hunt, E.J., Finch, A.A., *Minerals* (In Press) Hydrothermal Alteration of Eudialyte-Hosted Critical Metal Deposits: Fluid Source and Implications for Deposit Grade
- Borst, A.M.**, Waight, T.E., Finch, A.A., Storey, M., Le Roux, P.J (2019) Dating apaitic rocks: A multi-system (U/Pb, Sm/Nd, Rb/Sr and ⁴⁰Ar/³⁹Ar) isotopic study of layered nepheline syenites from the Ilímaussaq complex, Greenland, *Lithos* 324-325, 74-88
- Borst, A.M.**, Friis, H., Waight, T.E., Nielsen, T.F.D. (2018) Bulk and mush melt evolution in apaitic systems: Insights from compositional variations in eudialyte-group minerals of the Ilímaussaq complex, South Greenland, *Journal of Petrology* 59:4. p. 589-612
- Borst A.M.**, Friis, H., Andersen, T., Waight, T.E., Nielsen, T.F.D., Smit, M. (2016) Zirconosilicates in the kakortokites of the Ilímaussaq complex, South Greenland: Implications for fluid evolution and HFSE-REE mineralisation in apaitic systems, *Mineralogical Magazine* 80(1), p. 1-26
- Borst, A.M.**, Foing, B.H., Davies, G.R., van Westrenen, W. (2012) Surface mineralogy and stratigraphy of the lunar South Pole-Aitken basin determined from Clementine UV/VIS and NIR data, *Planetary and Space Science* 68, Terrestrial Planets 1, p. 76-85

INVITED TALKS

- JUNE 2019 **Global Rare Earth Industry Association Conference**. Brussels, Belgium. "Secondary alteration in rare earth deposits – implications for processing and extraction"
- MAY 2019 Early Career Researcher Keynote **3rd International Critical Metals Conference**. Edinburgh, United Kingdom. "Peralkaline-hosted Critical Metal Deposits: From magmatic enrichment to hydrothermal mobilisation"
- NOV 2018 **Symposium on Rare Earth Elements**. University of São Paulo, Brazil "Subsolidus mobility of REE in the Ilímaussaq complex, Greenland"
- JUNE 2017 **British Geological Survey**, NIGL, Keyworth UK. "Reconstructing an ancient Rift: the Gardar Province"
- JUNE 2016 **USGS Geological Survey**, Denver, USA. "REE mineralisation in the Ilímaussaq complex, Greenland"

PROFESSIONAL SKILLS

Analytical skills: Thin section preparation, petrography and microstructural analyses (microscopy, CL, BSE, XRD), Mineral separation (heavy liquids, magnetics, picking, mounting), Mineral and whole rock geochemistry (XRF, ICPMS, EPMA, LA-ICPMS, SEM-EDX), Clean Lab work (sample digestion, column chemistry), Isotope geochemistry (MC-ICPMS, ID and IC-TIMS and MC-LA-ICPMS, CA-ID-TIMS), Synchrotron X-ray absorption spectroscopy (XANES, EXAFS)

Field skills: Geological mapping, sampling and field experience in Greenland, Brazil, Belgium, Spain, France, USA, South Africa, Botswana, Scotland, Cyprus, Serbia, Montenegro, Germany and the Netherlands

Conference organization: VMSG local organizing committee 2019, Nordic Geological Winter Meeting session chair 2018, SOS RARE local organizing committee 2017, Magmas and Resources fortnightly group meetings, SGA field excursion guide Gardar Province Greenland 2016, EGU 2009

Teaching: Lecturer in **Magmatic Ore Deposits** (ES5300, UniStA), **Introduction to Earth Science** (ES1901, UniStA) & **Radiogenic isotope geochemistry** (UCPH). Field and Lab demonstrator on **Field mapping course** (ES3006, UniStA) to the Isle of Mull, **Digital mapping course** (ES5305, UniStA) to the Isle of Rum, **Igneous and Metamorphic Petrology** (ES3009, UniStA), **Advanced Petrogenesis** (ES5013, UniStA), **Metallogenesis** (ES5006, UniStA), **Advanced Field Methods** course in Utah, USA (UCPH) and **Lithospheric Geology and Geochemistry** fieldtrip to Sorbas Spain (UCPH). Supervised 3 MSc Dissertation students (UniStA)

Committees: Early Career Researchers Forum Social Representative, L'AVA sorority, GeoVUsie Study Association Amsterdam, AAPG/SPE Amsterdam Student Chapter

Journal referee: Reviewer for Dansk Geologisk Forening Bulletin, Journal of Geosciences, Journal of Petrology, Johnson Matthey Technological Reviews, Lithos, Mineralogical Magazine, Minerals and Nature Scientific Reports

Languages: Dutch (native), English (fully professional proficiency), Danish (elementary proficiency)

REFERENCES

Prof Adrian A. Finch

University of St Andrews, School of Earth & Env. Sciences
North Street, KY16 8JY, St Andrews
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Prof Tod E. Waight

University of Copenhagen, Geology Section
Øster Voldgade 10, 1350 København K
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