Jean-François Smekens, Ph.D.

Volcanology | Remote Sensing | Planetary Surfaces

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Research Interests

- **Volcanic emissions:** Study of the composition, magnitude and transport of volcanic gases, ashes and aerosols, and the hazards they pose.
- **Physical volcanology:** Understanding conduit dynamics of persistent volcanic activity using monitoring methods and numerical modeling.
- **Volcano monitoring:** long-term observation of volcanic activity using remote sensing methods.
- **Spectroscopy (VNIR, TIR, UV) and Imaging techniques:** Tools for the characterization of natural surfaces and the observation of active geological processes

Education

2015 **Ph.D. in Geological Sciences** – Arizona State University, Tempe, AZ, USA

2005 **M.Sc. in Volcanology** – Université Blaise Pascal, Clermont-Ferrand, France

2004 **License in Geological Sciences** – Université de Liège, Belgium

Employment History

2019-23 **Postdoctoral Research Assistant**
Department of Earth Sciences, University of Oxford, Oxford, UK

2017-19 **Postdoctoral Scholar**
Department of Astronomy and Planetary Science, Northern Arizona University, Flagstaff, AZ, USA

2015-17 **CNES Postdoctoral Researcher**
Laboratoire Magmas et Volcans, Université Clermont Auvergne, Clermont-Ferrand, France

2008-15 **Graduate Teaching/Research Assistant**
Arizona State University, Tempe, AZ, USA

Teaching & Mentoring Experience

- **Instructor** – Northern Arizona University (2018)
  - AST 599: Planetary Analogs Field Course
- **Practical Laboratory Coordinator** (including development of lab content) online and in-person (2011-2015)
  - GLG 110/111 – Dangerous World -– 8 semesters
- **Graduate Teaching Assistant** – Arizona State University (2008-2010)
  - GLG 420 Volcanology – 2 semesters
  - GLG 103 Introduction to Geology lab section – 2 semesters
- **Undergraduate Research Mentor** - Research Experiences for Undergraduates (REU) program at NAU
  - Alexander Kling (2019): 'Creating a spectral database of volcanic ash samples'
  - Fadwa Al Jaberi (2018): 'Mapping pyroclastic deposits on Mars'
- **Graduate Research Mentor** – Development of a secondary project, NAU

- Christopher Wolfe (2019): 'Development and Validation of a low-cost, weather resistant imaging system for volcanic emissions'

Relevant Research Experience

Field Experience

- **Ground-based measurements of volcanic degassing**: participated in >15 and coordinated 5 campaigns on active volcanoes: Semeru (2013), Stromboli (2015, 2019, 2021), Fagradalfsjall (2021)
  - Multiple locations around the world: Italy, Indonesia, Guatemala, Columbia, Iceland
  - Data collection strategies and data analysis
- **Sample collection** for validation of remotely sensed data
  - Volcanic ash: near-vent fall deposits and in-situ drone sampling
  - Geo-localized natural surfaces for ground-truthing of orbital data
  - Planetary analogues studies

Experience with Laboratory and Field Instruments

- Benchtop **TIR Michelson Interferometer** for the characterization of natural materials
- Compact **UV diffraction spectrometers** and narrow FOV telescopes for the detection and quantification of volcanic and anthropogenic gas emissions (DOAS technique)
- **Open-Path Fourier Transform Infrared** (OP-FTIR) spectrometer for the determination of the composition of volcanic plumes
- Field-ready **Hyperspectral TIR imager** (TELOPS Hyper-Cam LW)
- **SO_2 camera**: a synchronized dual UV imager with bandpass filters and co-located UV spectrometer for the measurement of volcanic and anthropogenic gas emissions
- **Broadband IR cameras** (FLIR) for the observation of thermal volcanic features

Experience with Satellite Data

- **IASI**: IR spectrometer, EUMETSAT, sun-synchronous polar orbit (METOP satellite)
- **MSG-SEVIRI**: multi-spectral imager, EUMETSAT, geostationary orbit (METEOSAT satellite)
- **MODIS**: multi-spectral imager, NASA, sun-synchronous polar orbit (Terra and Aqua satellites)
- **ASTER**: multi-spectral imager, NASA, sun-synchronous polar orbit (Terra satellite)
- **OMI**: UV imaging spectrometer, NASA, sun-synchronous polar orbit (Aura satellite)
- **TIMS**: multi-spectral TIR imager, airborne, NASA, deployment by request
- **MASTER**: airborne ASTER and MODIS simulator, NASA deployment by request

Refereed Publications

Manuscripts submitted for publication

[8] **Smekens, J-F.,** Mather T., Burton M., Varnam M. and Pfeffer M.: Rapid primary sulphate aerosol generation observed with OP-FTIR in the eruptive plume of the Fagradalfsjall basaltic eruption, Iceland, 2021. [*submitted to J. Geophys. Res.*]

[7] Pfeffer, M., Arellano, S., Barsotti, S., **et al.** (**including Smekens, J-F.**) : SO_2 emission rates and incorporation into the air pollution dispersion forecast during the 2021 eruption of Fagradalsfjall, Iceland. [*J. Volcanol. Geotherm. Res*.]

Published in peer-reviewed journals

[6] **Smekens, J-F.**, Mather T., Burton M., La Spina A., Kabbabe K., Esse B., Varnam M. and Grainger R. (2023): Quantification of gas, ash, and sulphate aerosols in volcanic plumes from open path Fourier transform infrared (OP-FTIR) emission measurements at Stromboli volcano, Italy. *Front. Earth Sci.*, https://doi.org/10.3389/feart.2022.1005738.

[5] **Smekens, J-F.**, and Gouhier, M. (2018): Observation of SO2 Degassing at Stromboli Volcano using a Hyperspectral Thermal Infrared Imager. *J. Volcanol. Geotherm. Res*., 356,: 75-89, https://doi.org/10.1016/j.jvolgeores.2018.02.018.

[4] **Smekens, J-F.**, Clarke, A.B., Burton, M.R., Harijoko, A., and Wibowo, H. (2015): SO_2 emissions at Semeru volcano, Indonesia: characterization and quantification of persistent periodic explosive activity. *J. Volcanol. Geotherm. Res*., 300: 121-128, http://dx.doi.org/10.1016/j.jvolgeores.2015.01.006.

[3] **Smekens, J-F.**, Burton, M.R., and Clarke, A.B. (2015): Validation of the SO_2 camera for high temporal and spatial resolution monitoring of SO_2 emissions. *J. Volcanol. Geotherm. Res.*, 300: 37-47, http://dx.doi.org/10.1016/j.jvolgeores.2014.10.014.

[2] Kern, C., Lübcke, P., Bobrowski, N., Campion, R., Mori, T., **Smekens, J-F.**, Stebel, K., Tamburello, G., Burton, M., Platt, U., and Prata, F. (2015): Inter-comparison of $_{SO2}$ camera systems for imaging volcanic gas plumes. *J. Volcanol. Geotherm. Res*., 300: 22-36, http://dx.doi.org/10.1016/j.jvolgeores.2014.08.026.

[1] Vanderkluysen, L., Burton, M.R., Clarke, A.B., Hartnett, H.E., and **Smekens, J-F.** (2014): Composition and flux of explosive gas release at LUSI mud volcano (East Java, Indonesia). *G^3*, http://dx.doi.org/10.1002/2014gc005275.

Funding & Awards

2024-26 (selected)	**NASA Earth Surface and Interior: NNH23ZDA001N-ESI** 'UAS thermal infrared spectroscopy will improve real time evaluation of hazards and environmental impacts of wildfires' (23-ESI23-0037) Named postdoc (now paid collaborator)| PI: M. Ramsey | 0.5 FTE/yr for 3 yr	**$K354** ($K664 total)
2024-25 (selected)	**NASA FireSense Technology: NNH22ZDA001N-FIRET** 'UAS thermal infrared spectroscopy will improve real time evaluation of hazards and environmental impacts of wildfires' (22-FIRET22-0044) Named postdoc (now paid collaborator)| PI: J. Thompson | 0.17 FTE/yr for 2 yr	**$K150** ($M1.5 total)
2020-21	**STFC (UK): Collaborative Scoping Studies Award** 'A UAV-ready sensor package for rapid deployment during volcanic crisis' PI: D. Peters	£7,982
2015	**Pitching Competition,** School of Earth and Space Exploration, ASU	$500
2014	**University Graduate Fellowship**, School of Earth and Space Exploration, ASU	$11,500

2013	**Summer PhD Student Research Award**, School of Earth and Space Exploration, ASU	($6.891)
2013	**Doctoral Research Grant Program**, Arizona Board Of Regents	($5,000)

Oral presentations

Invited talks

- **COMET+ webinar series** – November 25th, 2023: 'Aerosol formation in young volcanic plumes: insights from OP-FTIR measurements'
- **USGS Cascades Volcano Observatory** – January 24th, 2023: 'Measuring plume composition from a distance: recent advances in OP-FTIR methodology'
- **Drexel University** – April 10th, 2018: 'Observation of volcanic degassing using ground-based imaging methods'
- **University of Oslo** – April 6th, 2017: 'Observation of volcanic degassing using ground-based imaging methods'
- **University of Bristol** – May 6th, 2016: 'Quantifying passive and explosive degassing using ground-based imaging methods'
- **USGS Cascades Volcano Observatory** – July 31st, 2013: 'New developments in UV imaging techniques and application to volcanological problems'
- **Vrije Universiteit van Brussels** – January 15th, 2013: 'New developments in UV imaging for the monitoring of volcanic SO_2'

Conference and Workshop talks

- **IAVCEI General Assembly** (Rotorua, New Zealand) – February 2nd, 2023: 'Quantifying sulphate aerosol abundance in OP-FTIR spectra: a new tool for volcano monitoring'
- **Plume Imaging Workshop** (Stromboli, Italy) - June 24th, 2013: 'New developments in UV imaging for the monitoring of volcanic SO_2'
- **AGU Fall Meeting** - December 13th, 2010: 'SO_2 emissions from persistently active explosive volcanoes: can we estimate their contribution using satellite instruments?'
- **Plumes and PDC workshop** (Clermont-Ferrand, France) - October 26th, 2009: 'Cyclic patterns of SO_2 emissions at Santiaguito volcano, Guatemala, revealed by UV camera measurements'

Community Service

- Moderator of **The Collective**: a discussion group on matters of diversity and inclusion, NAU: 2018-2019
- President of the **Graduate Student Council**, School of Earth and Space Exploration, ASU: 2011-2013
- Moderator for the **VOLCANO listserv**: 2011-2013
- Website manager for the **Commission on Explosive Volcanism (CEV)** webpage: 2011-2014
- **Review panelist** for funding programs (NASA)
- **Reviewer for scientific journals** (J.Volcanol. Geotherm. Res., Rem. Sens., Atmos. Meas. Tech., J. Imaging, Geochem. Cosm. Acta.)
- Chair for **topical sessions at scientific meetings** (AGU 2012, GSA 2019)

Professional Memberships

- Member of the **European Geophysical Union (EGU)**: 2020-now
- Member of the **Geological Society of America (GSA)**: 2019-now
- Member of the **International Association for Volcanology and Chemistry of the Earth's Interior (IAVCEI)**: 2016-now

- Member of the **American Geophysical Union (AGU)**: 2010-now

International Collaborations

- **Arizona State University**, USA (Profs. Amanda Clarke and Philip Christensen)
- **University of Manchester**, UK (Prof. Mike Burton)
- **University of Oxford**, UK (Profs. Tamsin Mather and David Pyle)
- **Laboratoire Magmas et Volcans**, Clermont-Ferrand, France (Prof. Mathieu Gouhier)
- **Northern Arizona University** (Profs. Christopher Edwards and Mark Salvatore)
- **Istituto Nazionale de Geofisica e Vulcanologia**, Italy (Drs. Mattia de'Michieli Vitturi and Allessandro LaSpina)
- **Universitas Gadjah Mada**, Yogyakarta, Indonesia (Profs. Agung Harijoko and Gayatri Marliyani)
- **Drexel University**, Philadelphia, USA (Prof. Loÿc Vanderkluysen)
- **Hawaii Volcano Observatory**, USGS (Dr. Brett Carr)
- **USGS Astrogeology Center**, Flagstaff, USA (Drs. Kristen Bennett and Lauren Edgar)
- **NASA Johnson Space Center**, Houston, USA (Dr. Elizabeth Rampe)
- **NASA Goddard Space Flight Center**, Washington D.C., USA (Dr. Kelsey Young)

Additional Relevant Skills

Scientific Programming

- **Labview:** Development of acquisition software for UV imaging instrument (GUI, instrument parameterization, synchronization of data acquisition with multiple instruments, organization of the data flow)
- **IDL + ENVI:** Image processing, spectral analysis, forward modeling
- **Matlab:** Image processing, spectral analysis, forward modeling, instrument operation
- **Fortran 95:** Numerical modeling
- **Python:** Image and signal processing

Petrological and Geochemical Analysis

- **Sample preparation**: dissolution, dilution
- **Microscopy**: Optical microscope, Scanning Electron Microscope
- **Geochemistry**: Electron microprobe, ICP-MS, XRF spectrometer

Language proficiency

- **French**: native tongue
- **English**: Excellent written and oral proficiency (fluent)
- **Dutch**: Moderate written proficiency, low oral proficiency (high school level as a second language)