About me: Hi, I'm Marco, a CNRS research associate (*ingénieur de recherche*) at Géosciences Montpellier in France. I hold a *PhD* in Geology from the University of Oviedo in Spain. In the past, I combined jobs outside the academy as a geology teacher and freelance geologist with postdoctoral training in Sergio's Llana-Fúnez research group. At the beginning of 2018, I joined the *Manteau et Interfaces* research group in Montpellier under the direction of Andréa Tommasi, being part of the The Project - RhEOVOLUTION and where my research focuses on characterizing the evolution of microstructure and crystallographic preferred orientation during deformation and annealing using in-situ monitoring, Electron Backscatter Diffraction (EBSD), and Digital Image Correlation (DIC) techniques. More info also here: https://marcoalopez.github.io/IDEAproject/

My research interests include different aspects of geodynamic processes from the microscopic to the orogenic scale and exploring the physical properties of Earth solid materials (rock/mineral physics). My primary interest is to understand how microstructure and crystal preferred orientation affects the mechanical and elastic properties of rocks, including how rocks respond to an applied force (deformation and rheology) or their seismic properties. Other interests are crustal strength modelling, understanding strain localization at all scales, the evolution of ancient orogens, and the interaction between rock deformation, fluids and metamorphism. I enjoy programming and am an advocate of open source and open science. I like to create small projects to promote earth sciences through programming.

Personal details

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Research Gate: https://www.researchgate.net/profile/Marco-Lopez-Sanchez
Outreach:
Marco A. Lopez-Sanchez (@lsmarcoa) / Twitter,
https://medium.com/@marcoalopez

Education

2013
PhD in Geology, *cum laude* honours, University of Oviedo (Spain)
Thesis: *Tectonic analysis of the Vivero fault (Galicia, NW of Spain) (original in Spanish)*
Advisors: Sergio Llana-Fúnez, Alberto Marcos and Francisco J. Martínez
Topic: Analysis of the microstructure, metamorphism processes, and age of a crustal-scale fossil shear zone.

2007 - Diploma of Advanced Studies (**DEA**) in the (interuniversity) program "*Exploration, analysis and modelling of basins and orogenic systems*" from the University of Oviedo and University of Barcelona
Project advisor: Alberto Marcos

2006 - I graduated with a **Bachelor of Science in Geology** from the University of Oviedo in January 2006.

Research

Appointments (only academic related)

2020 - present - CNRS research associate "*ingénieur de recherche*" at Géosciences Montpellier, Université de Montpellier (France)

2018 - 2020 - Marie Sklodowska-Curie Clarín-COFUND postdoctoral researcher at Géosciences Montpellier, Université de Montpellier (France). *24 months of full-time postdoc.*

2015 - 2017 - Postdoctoral researcher, Departamento de Geología, Universidad de Oviedo. *This includes several full and part-time postdoc contracts that add up to a year of experience within this period*

2007 - 2013 - *PhD candidate*, Departamento de Geología, Universidad de Oviedo

Fellowships/Awards

2021 - Marie Sklodowska-Curie Actions Seal of Excellence_Award with the reserach project proposal START

2017 - Postdoctoral fellowship Clarín-COFUND (Marie Sklodowska-Curie Clarín-COFUND Actions FP7) (2 years)

2017 - Marie Sklodowska-Curie Actions Seal of Excellence Award with the research project proposal IDEA

2016 - Early Career Scientist's Travel Award for EGU General Assembly 2016

2007 - Predoctoral fellowship in the Severo Ochoa Program (FICYT, Principality of Asturias, Spain) (4 years)

Scientific activities as a visitor researcher

2019 - **Grenoble (France)**. Duration: 1.5 months. **Goal**: Experimental ice deformation (creep) using digital image correlation methods at Institut des Géosciences de l'Environnement under the supervision of Maurine Montagnat.

2018 - **Saint-Étienne (France)**. Duration: 1 week. **Goal**: High temperature experimental deformation of magnesium alloys in a channel-die compression rig at École des Mines de Saint-Étienne (collab. R. Quey).

Publications

In review or available as a pre-print

Ben Ismail W, Tommasi A, **Lopez-Sanchez MA**, Rutter EH, Barou F, Demouchy S. Deformation of upper mantle rocks with contrasting initial fabrics in axial extension. *Tectonophysics*, accepted with major revision in April 2021, *in revision*. Preprint here

Wang X, Zhang J, Tommasi A, **Lopez-Sanchez MA**, Liu W, Barou F. Experimental evidence for a weak amphibole-rich deep crust in orogens. *Nature Communications*, accepted with major revision in Feb. 2021, *in revision*.

Lopez-Sanchez MA, Demouchy S, Thoraval, C. Comment on "If not brittle: Ductile, Plastic, or Viscous? By Kelin Wang. Submitted to *Seismological Research Letters.* in June 2021.

Published or in press (citable) peer-reviewed publications

2021

- **Lopez-Sanchez MA**, Tommasi A, Ben Ismail W, Barou F. Dynamic recrystallization by subgrain rotation in olivine revealed by electron backscatter diffraction. *Tectonophysics in press:* 228916 https://doi.org/10.1016/j.tecto.2021.228916 Preprint here
- Cárdenes V, **Lopez-Sanchez MA**, Barou F, Olona J, Llana-Fúnez S. Crystallographic preferred orientation, seismic velocity and anisotropy in roofing slates. *Tectonophysics* **808**: 228815 https://doi.org/10.1016/j.tecto.2021.228815

2020

- **Lopez-Sanchez MA**, Tommasi A, Barou F, and Quey R. (2020) Dislocation-driven recrystallization in AZ31B magnesium alloy imaged by quasi-in situ EBSD in annealing experiments. *Materials Characterization* **165**: 110382 https://doi.org/10.1016/j.matchar.2020.110382 / get the PDF !
- Wenk HR, Yu R, Cárdenes V, **Lopez-Sanchez MA**, Sintubin M. (2020) Fabric and anisotropy of slates: From classical studies to new results. *Journal of Structural Geology* **138**: 104066 https://doi.org/10.1016/j.jsg.2020.104066 / get the PDF !
- **Lopez-Sanchez MA** (2020) Which average, how many grains, and how to estimate robust confidence intervals in unimodal grain size populations. *Journal of Structural Geology* **135**: 104042 https://doi.org/10.1016/j.jsg.2020.104042 / get the PDF !

2019

- **Lopez-Sanchez MA**, García-Sansegundo J, and Martínez, FJ (2019) The significance of early Permian and early Carboniferous U-Pb zircon ages in the Bossòts and Lys-Caillaouas granitoids (Pyrenean Axial Zone). *Geological Journal* **54**: 2048-2063 https://doi.org/10.1002/gj.3283 / get the PDF !

2018

- **Lopez-Sanchez MA** (2018) GrainSizeTools: a Python script for grain size analysis and paleopiezometry based on grain size. *Journal of Open Source Software* **3**: 863, https://doi.org/10.21105/joss.00863 / get the PDF !
- **Lopez-Sanchez MA** and Llana-Fúnez S (2018) A cavitation-seal mechanism for ultramylonite formation in quartzfeldspathic rocks within the semi-brittle field (Vivero fault, NW Spain). *Tectonophysics* **745**: 132-153 https://doi.org/10.1016/j.tecto.2018.07.026 / get the PDF !

2016

- **Lopez-Sanchez MA** and Llana-Fúnez S (2016) An extension of the Saltykov method to quantify 3D grain size distributions in mylonites *Journal of Structural Geology* **93**: 149-161; https://doi.org/10.1016/j.jsg.2016.10.008 / get the PDF !
- **Lopez-Sanchez MA**, Aleinikoff J, Marcos A, Martínez FJ, and Llana-Fúnez S. (2016) An example of low Th/U zircon overgrowths of magmatic origin in a late orogenic variscan intrusive: the San Ciprián Massif (NW Spain). *Journal of the Geological Society* **173**: 282-291; https://doi.org/10.1144/jgs2015-071 / get the PDF !

2015

- **Lopez-Sanchez MA** and Llana-Fúnez S (2015) An evaluation of different measures of dynamically recrystallized grain size for paleopiezometry or paleowattmetry studies. *Solid Earth* **6**: 475-495; https://doi.org/10.5194/se-6-475-2015 / get the PDF !
- **Lopez-Sanchez MA**, Marcos A, Martínez FJ, Llana-Fúnez S, and Iriondo A (2015) Setting new constrains on the age of crustal-scale normal fault (Vivero Fault): Implications for the evolution of Variscan orogeny in the Iberian Massif. *International Journal of Earth Sciences* **104**: 927-962; https://doi.org/10.1007/s00531-014-1119-1 / get the PDF !
- **Lopez-Sanchez MA**, Iriondo A, Marcos A, and Martínez FJ (2015) A U-Pb zircon age (479±5 Ma) from the uppermost layers of the Ollo de Sapo Fm near Viveiro (NW Spain): implications for the duration of rifting-related Cambro-Ordovician volcanism in Iberia. *Geological Magazine* **152**: 341-350; https://doi.org/10.1017/S0016756814000272 / get the PDF !

Others

López-Sánchez MA (2007) Estudio geológico de la Falla de Vivero y estructuras asociadas en la región de Guntín (Lugo, NO de la Península Ibérica). *Trabajos de Geología* **27**: 97-157 link

Field Trip guides

Marcos A, Bastida F, Aller J, Fernández FJ, Llana-Fúnez S and **Lopez-Sanchez MA** (2011) DRT post-conference Fieldtrip Guide: West Asturian Leonese Zone, Cabo Ortegal, Malpica-Lamego Line. *Deformation, Rheology and Tectonics (DRT - Oviedo) meeting* 42 pp + map. get the PDF!

Meeting proceedings

- 2020 - **Lopez-Sanchez MA**, Tommasi A, Ben Ismail, W and Barou, F. Dynamic recrystallization by sub-grain rotation in olivine-rich rocks (Oral). *GRD Recrystallization and Grain Growth workshop (Les Houches, School of Physics, France)*
- 2020 - **Lopez-Sanchez MA**, Tommasi A, Barou, F and Quey R. In-situ annealing EBSD experiments in magnesium alloy AZ31B with variable deformation microstructures (Oral). *GRD Recrystallization and Grain Growth workshop (Les Houches, School of Physics, France)*
- 2019 - **Lopez-Sanchez MA**, Tommasi A, Barou, F and Quey R. In-situ annealing EBSD experiments in magnesium alloy AZ31B with variable deformation microstructures (Oral). *GRD meeting (Grenoble, France)*
- 2019 - **Lopez-Sanchez MA**. Which measure of central tendency is most appropriate in grain size studies? (Poster). *Deformation mechanisms, Rheology and Tectonics (DRT) 2019 (Tübingen, Germany)*
- 2019 - **Lopez-Sanchez MA**, Tommasi A, Barou, F and Quey R. EBSD in-situ annealing experiments on magnesium alloy (AZ31): how dislocations and interfaces affect recrystallization and final grainsize (Oral). *Deformation mechanisms, Rheology and Tectonics (DRT) 2019 (Tübingen, Germany)*
- 2019 - Cárdenes V, **Lopez-Sanchez MA**, Barou, F, Olona, J and Llana-Fúnez S. Seismic anisotropy in fine-grained slates from NW Spain (Poster). *Deformation mechanisms, Rheology and Tectonics (DRT) 2019 (Tübingen, Germany)*
- 2019 - **Lopez-Sanchez MA**, Tommasi A, Barou, F and Quey R. Preliminary results on magnesium (AZ31) in situ annealing experiments in the SEM-EBSD (poster). *Final CREEP workshop (Les Houches - France)*
- 2017 - Llana-Fúnez S, Alonso JL, Caldera N and **Lopez-Sanchez MA**. Fault rocks at the base of the Somiedo Nappe (Variscan Orogen, NW Spain). *Deformation mechanisms, Rheology and Tectonics (DRT) 2017 (Inverness,*

Scotland)

- 2017 - Llana-Fúnez S, de Paola N, Pozzi G and **Lopez-Sanchez MA**. Slip events propagating along a ductile mid-crustal strike-slip shear zone (Malpica-Lamego line, Variscan Orogen, NW Iberia). *European Geoscience Union General Assembly*
- 2016 - **Lopez-Sanchez MA** and Llana-Fúnez S. Characterizing 3D grain size distributions from 2D sections in mylonites using a modified version of the Saltykov method (Oral). *European Geoscience Union General Assembly*
- 2016 - **Lopez-Sanchez MA** and Llana-Fúnez S. Caracterización de la distribución 3D de tamaños de grano en milonitas a partir de secciones usando el método Saltykov y una extensión del mismo (Oral). *Congreso Geológico Nacional de España*
- 2012 -**Lopez-Sanchez MA**, Llana-Fúnez S, Marcos A and Martínez FJ. Deformation of quartz and feldspar at mid-crustal depths in an extensional normal fault (Vivero Fault, NW Spain) *(Poster). European Geoscience Union General Assembly*
- 2012 - **Lopez-Sanchez MA**, Iriondo A, Marcos A and Martínez FJ. Una edad de 478,7 Ma (U-Pb Shrimp-RG) en la Formación Ollo de Sapo: implicaciones para el volcanismo Cambro-Ordovícico de la Península Ibérica (Poster). *Congreso Geológico Nacional de España*
- 2011 - **López-Sánchez MA**, LLana-Fúnez S, Martínez FJ and Marcos A. Strain gradient recorded in the Penedo Gordo granite during extensional movement of crustal-scale Vivero Fault (NW Spain) *(Poster). European Geoscience Union General Assembly*
- 2011 - **López-Sánchez MA**, LLana-Fúnez S, Martínez FJ and Marcos A. Changes in deformation mechanism and neocrystallisation in granite during a MT-LP deformation (Vivero Fault, NW Spain) *(Poster). Deformation, Rheology and Tectonics meeting (Oviedo)*
- 2011 - **López-Sánchez MA**, Llana-Fúnez S, Martínez FJ and Marcos A. Microstructural Evolution in Quartz and Feldspar During Medium T Deformation (Vivero Fault, NW Spain) *(Poster). The Interrelationships Between Deformation and Metamorphism*
- 2011 - **López-Sánchez MA**, Marcos A, Martínez FJ and Llana-Fúnez S. Hangingwall Metamorphism Related to an Extensional Orogen-scale Shear Zone: The Vivero Fault (NW of Spain) *(Poster). The Interrelationships Between Deformation and Metamorphism*
- 2010 - **López-Sánchez MA**, Marcos A, Martínez FJ and Llana-Fúnez S. Microstructures from the footwall to the hangingwall in the Viveiro Shear Zone (NW of Iberian Peninsula) **(Oral - by invitation)**. *Sociedade Geológica de Portugal, VIII Congresso Nacional de Geología*.
- 2009 - **López-Sánchez MA**. Deformation partitioning patterns and metamorphism of the Viveiro shear zone (Guntín, NW of Iberian Peninsula) *(Poster). Deformation, Rheology and Tectonics meeting (Liverpool)*

Peer review activity

- **Journal articles:** *Tectonophysics, Journal of Structural Geology, Image Analysis and Stereology, Italian Journal of Geosciences*
- **Research grants:** US National Science Foundation (NFS) grant reviewer in 2019.

Selected scripts & codes

GrainSizeTools: A free and open-source Python script for estimating the grain size from thin sections
Info. & download: http://marcoalopez.github.io/GrainSizeTools/

Strength envelopes: A set of Jupyter notebooks to generate crust and lithoshere strenght envelopes
Info. & download: https://marcoalopez.github.io/strength_envelopes/

Jupyter4DICe: a series of Jupyter notebooks written in Python for post-processing digital image correlation (DIC) data obtained with the open-source digital image correlation tool DICe
Info. & download: https://github.com/marcoalopez/Jupyter4DICe

JASPE: *Just Another Stereoplot (in a) Python Environment*
Info. & download: https://github.com/marcoalopez/JASPE

Nearest neighbour: A Python script to estimate nearest neighbour distance and perform nearest neighbour Monte Carlo simulations
Info. & download: https://github.com/marcoalopez/nearest_neighbour

Selected training courses / workshops

2021 - *Advanced workshop on digital image correlation*
Duration: 120 hours, Virtual EBSD 2021 meeting
Coordinator: João Quinta da Fonseca

2019 - *4th Innovative Training Network CREEP workshop (EU-H2020)*
Duration: 5 days, École de physique des Houches, Les Houches, France
Coordinator: Andrea Tommasi
Workshop focused on the rheology of geological materials. For details see here

2016 - *Thematic School – Recrystallization Mechanism in Materials*
Duration: 5 days (32 hours), Sète, France
Coordinator: Maurine Montagnat
Organized by the CNRS "Groupement de Recherche" on Recrystallization (GDR3436). Certificate

2015 - *Introduction to R Programming*
Duration: 10 hours
Instructor: Filip Schouwenaars
Microsoft edx course (DAT204x). Certificate

2013 - *Introduction to computer science and programming using Python*
Duration: 210 hours
Prof. Eric Grimson, Prof. John Guttag, Dr Chris Terman and Dr Larry Rudolph
Massachusetts Institute of Technology edx course (MITx - 6.00x). Certificate

2012 - *Scanning Electron Microscopy and its applications to analyses of Rock*s
Duration: 30 hours
Prof. John Wheeler, Dr Elisabetta Mariani and Dr Dan Tatham
Department of Earth, Ocean and Ecological Sciences, University of Liverpool

2008 - *Training course in microtectonics*
Duration: 30 hours
Prof. Cees W. Passchier
Institut für Geowissenschaften; Johannes Gutenberg-Universität Mainz (Germany).

Participation in Research Projects

2021 – present
ERC Advanced Grant RhEoVOLUTION project: Micro-scale dependent, time- and space-evolving rheologies: the key for generating strain localization in the Earth (PI: Andrea Tommasi). Grant agreement ID: 882450. **Role**: One-year *CNRS ingénieur de recherche* full-time contract (as part of the main team) under this project (Jan 2021 to Jan 2022).

2018 – 2021
Marie Curie Integrated Training Network (ITN) CREEP project: Complex RhEologies in Earth dynamics and industrial Processes (PI: Andrea Tommasi). Grant agreement ID: 642029. **Role**: One-year full-time CNRS *ingénieur de recherche* (research associate) contract under this project (Jan 2020 to Jan 2021) and covered some expenses for my scientific activities during my postdoctoral Marie Sklodowska-Curie Clarín-COFUND period in France.

2018 - 2019
ANR DREAM French research project: *Dynamic REcrystallization in Anisotropic Materials* (PI. Maurine Montagnat). Ref: ANR-13-BS09-0001-01. **Role**: Covered expenses for my scientific activities during my postdoctoral Marie Sklodowska-Curie Clarín-COFUND period in France (e.g. my stay in Grenoble).

2016 - 2017
MINECO (Spanish) research project: *Fracturing and cataclasis in continental crust rocks* (PI. Sergio Llana-Fúnez). Ref: MINECO-15-CGL2014-53388-P. **Role**: Part-time (5.5. months) and full-time (8 months) postdoctoral contract under this project.

2015
GRUPIN (regional) research project: *Procesos geológicos modeladores del relieve de la cordillera cantábrica* (PI. Sergio Llana-Fúnez). Ref: GRUPIN14-044. **Role**: Part-time (2 months) postdoctoral contract under this project.

2010 - 2013
MICINN (Spanish) research project: *The brittle-ductile transition in the continental crust in North-western Iberia* (PI. Sergio Llana-Fúnez). Ref: MICINN-10-CGL2010-14890. **Role**: Covered expenses for my research and scientific activities during my pre-doctoral period.

2007 - 2010
MICINN (Spanish) research project: *The tectonic evolution of an orogen in the transition between the internal and external zones: A comparison between the Variscan orogen in the NW of Iberian Peninsula and the Pyreneean Axial Zone* (original title in Spanish) (PI. Alberto Marcos) Ref: MICINN-06-CGL2006-08822/BTE. **Role**: Covered expenses for my research and scientific activities during my pre-doctoral period.

Analytical/technical skills

- **Scientific computing and programming**.
    - Wide experience using Python programming language and the scientific libraries Numpy, Scipy, Matplotlib, and Pandas.
    - Basic knowledge of MATLAB, R and Julia programming languages.
    - Familiarized with unit testing, version control systems (Git), and code repositories such as GitHub.
- **Image acquisition and analysis**.
    - Practical experience with cameras and digital image acquisition. Dcraw - raw image extraction.
    - Experience using ImageJ and scikit-image (Python library) - Noise reduction, image enhancement, grain segmentation, shape descriptors, and spatial analysis.
    - For **grain size analysis** I use my own tools/scripts. See an example in http://marcoalopez.github.io/GrainSizeTools/
    - Experience with **Digital Image Correlation** (DIC) methods. Generation and quality analysis of speckle patterns and DIC data treatment workflow using DICe and own Python codes.
- **Experimental deformation and annealing**.
    - Broad experience setting up annealing and deformation experiments in different configurations. In situ EBSD monitoring, tension and creep experiments.
    - Experience in sample preparation (ice - cold rooms, metals, and rocks).
    - Good theoretical background in interpreting experimental data (i.e. statistics, interpolation and regression using SciPy optimization package)
    - Others: Basic experience with LabVIEW. Welding skills.
- **Electron Backscatter diffraction (EBSD)** data treatment.
    - **Wide experience using the MTEX toolbox**. I also contributed to the MTEX through community scripts. See https://github.com/marcoalopez/mtex_scripts
    - Others: *AZtec HKL/Channel 5*, *PFch5 script*, and own codes.
- **Electron Probe Micro-analyser** (EPMA). Including monazite chemical dating (see https://github.com/marcoalopez/chemical_age_script)
- Experience in geological mapping and **Geographical Information Systems** (GIS)
- U-Pb geochronological data treatment

Teaching at university level and workshops

2020 – Workshop instructor: "*EBSD data treatment with MTEX*" at GRD Recrystallization and Grain Growth workshop 2020 (Les Houches, School of Physics, France).

2016: Accredited as an assistant teacher by the *National Agency for Quality Assessment and Accreditation of Spain* (ANECA) in 2016.

2009 - 2011: Graduate teaching assistant at the Universidad de Oviedo during my pre-doctoral stage (~130 hours of experience)

- Laboratory sections taught: *Plate Tectonics (30 hours); Structural Geology (20 hours); Geophysical and Geochemical prospecting (10 hours); Interpretation of geological maps (10 hours)*
- Field Camp taught: *Geodynamics (10 hours); Structural Geology (10 hours); Fieldwork (geological mapping) (12.5 hours); Tectonics (10 hours); Structural analysis (5 hours)*

Administrative experience

Deformation mechanisms, Rheology and Tectonics (DRT2011) meeting organizing committee. DRT meetings are a series of biannual international meetings dedicated to the study of deformation processes in rocks at different scales, from the microscale to the study of bulk deformation of the lithosphere

Languages

Spanish and Galician - mother tongue
English - fluent
French - B1
Portuguese - Posso falar um bocadinho! :)

Header image ("the road") by Kamil Lehmann on Unsplash (CC0)
Hosted on GitHub Pages — Created with Typora