IMAP
ISTerre MicroAnalytical Platform

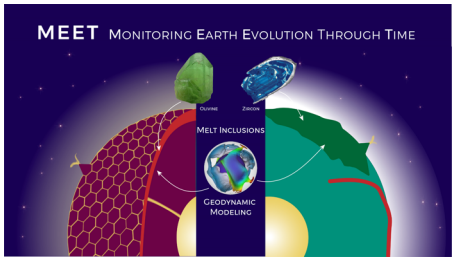
ISTerre
Institut des Sciences de la Terre

European Research Council
Established by the European Commission

Alexander Sobolev, Valentina Batanova, Adrien Vezinet, Valerie Magnin, Julien Leger, Ekaterina Diadkina, Carole Burget, Sasha Chugunov, Charbel Kazzy and Mateo Esteban

Fundings: *80% European Research Council (ERC) under the European Union's Horizon H2020 research and innovation program (Synergy Grant MEET, grant agreement no.856555); 20% Auvergne-Rhône-Alpes region (2020 AURA P3 - CPER 2015/2020) and CNRS-INSU.*

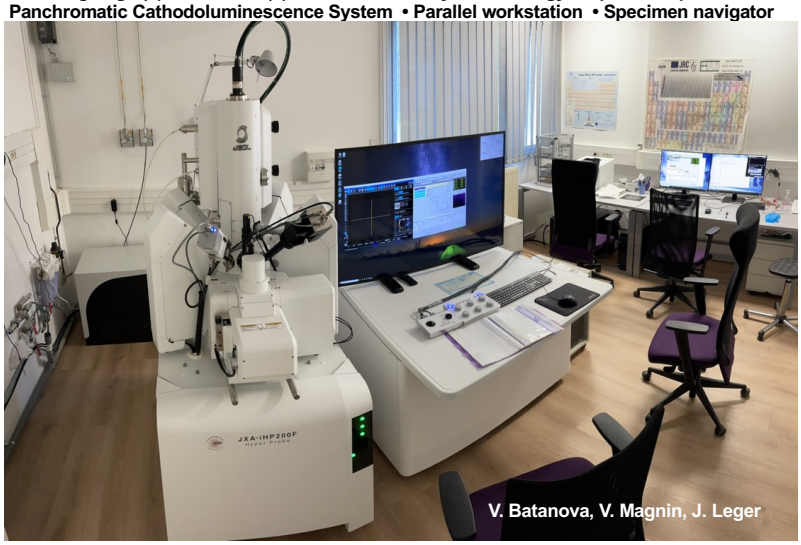
Steering committee: **Chair Matthias Bernet and 10 members.**



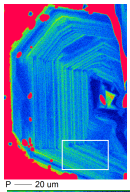
Field Emission Electron Microprobe Microanalyser JEOL JXA-iHP200F

Quantitative, qualitative and X-ray imaging of solid materials (minerals, glasses, alloys etc.) for chemical elements from B to U with spatial resolution down to 200 nm and detection limit down to few ppm; High spatial resolution (to 2 nm) secondary and back scattered electrons (to 50 nm) and Cathodoluminescence (to 200 nm) imaging.

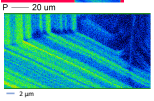
• Field Emission Schottky gun; • 5 Wavelength Dispersive Spectrometers with 10 crystals including large (2)TAPL, LIFL, (2)PETL, LDE1L • Dry SD30 Energy Dispersive Spectrometer • Panchromatic Cathodoluminescence System • Parallel workstation • Specimen navigator



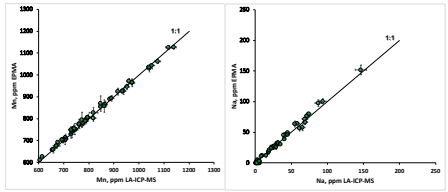
Quantitative analyses and imaging for major, minor and trace elements (down to DL 10 ppm) of mineral phases stable under electron beam current (olivine, zircon, garnet, magnetite, rutile, pyrite, corundum) for Geothermometry, Mantle - Crystal Geodynamic, Environment and Georesources



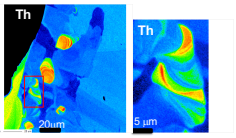
Phosphorus x-ray map of olivine from Gaussberg lamproite (Antarctica), P contents between 10 and 1000 ppm

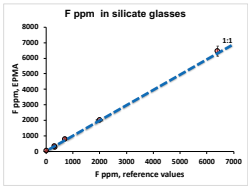


Comparison of Mn, Na in olivine from mantle xenoliths samples analyzed by EPMA and LA-QQQ-ICP-MS



Monazite Pb-Th-U and REE quantitative analysis and imaging for geochronology





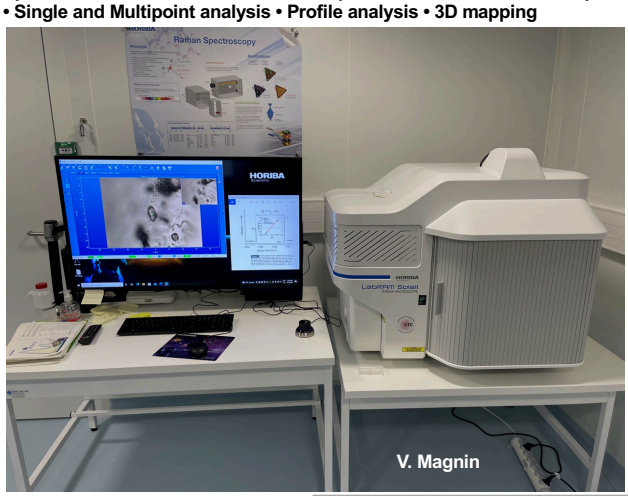
Fluorine analysis in basaltic glasses and mafic minerals down to 50 ppm DL

Reconstruction of volcanic source of historical climate events: analysis of tephra particles in Antarctic cores

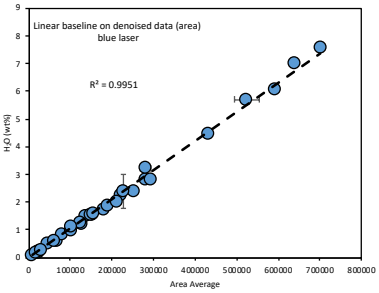
Planned: Low accelerating voltage quantitative analyses for submicron phases

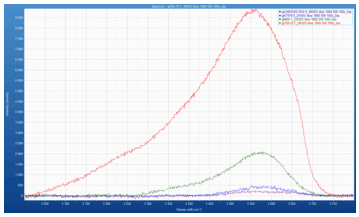
RAMAN microscope Horiba LABRAM Soleil

• Multimodal confocal imaging • Three lasers wavelengths: 473 nm, 532 nm, 638 nm.• Four gratings 600, 1200, 1800, 3000 g/mm • Nikon optical microscope 5X, 10X, 100X, 50X LD • Spectral range 20-4500 cm^{-1} • Spectral resolution down to 0.3 cm^{-1} • Spatial resolution down to 0.5 µm • Single and Multipoint analysis • Profile analysis • 3D mapping



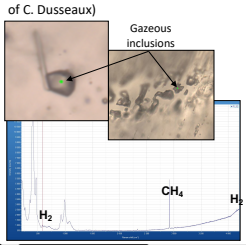
H_2O in glasses: H_2O+OH Raman bands





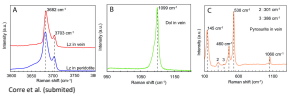
Gas storage in fluid inclusions (CH_4, H_2, etc)

Natural hydrogen exploration in peralkaline plutons:
the Kola peninsula, NW Russia (Post doc of C. Dusseaux)



Serpentine identification

Id. of lizardite vs chrysotile, dolomites solid solution, and pyroaurite in serpentinized peridotites from Oman ophiolite (PhD of M. Corre)



Planned: mapping, fluid/solid inclusions identification and quantification, in-situ reactions in silica capillaries for P, T determinations, carbon crystallography (microthermometry), RAMAN dating of zircon.

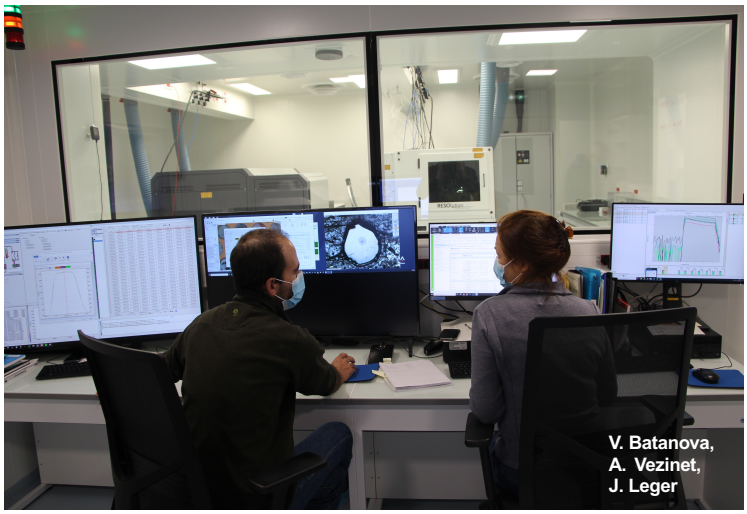
UGA Université Grenoble Alpes · cnrs · UNIVERSITÉ SAVOIE MONT BLANC · IRD Institut de Recherche pour le Développement FRANCE · Université Gustave Eiffel

fédération OSUG

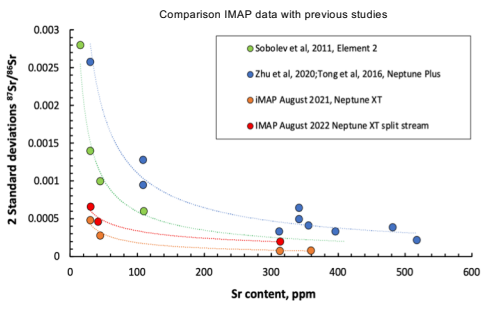
Split Stream Tandem LA-MC-ICP-MS/ QQQ-ICP-MS/ LIBS system

High precision and ultra-high precision isotope and trace elements geochemistry

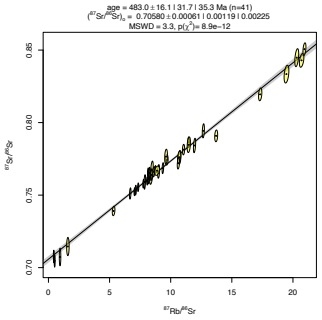
• Applied Spectra ResolutionSE ArF Excimer 193nm 5ns pulse laser, S155 Laurin Technic laser ablation cell • ThermoScientific Neptune XT MC-ICP-MS, four 10^{13} and six 10^{11}ohm amplifies, 9 Faraday caps and 6 ion counters • Agilent 8900 QQQ-ICP-MS reaction/collision cell • Integrated with LA-ICP-MS Applied Spectra laser-induced breakdown spectrometer (LIBS)



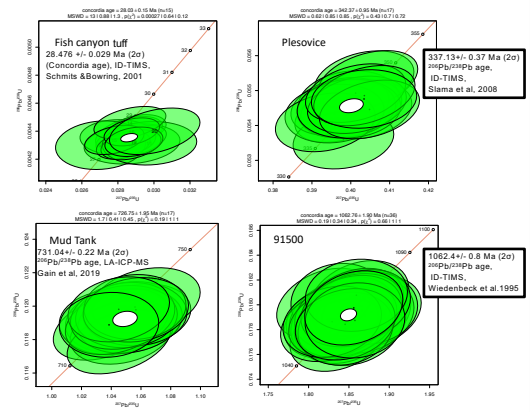
Sr isotopes in basaltic glasses LA-MC-ICP-MS



Rb/Sr isotopes dating LA-QQQ-ICP-MS

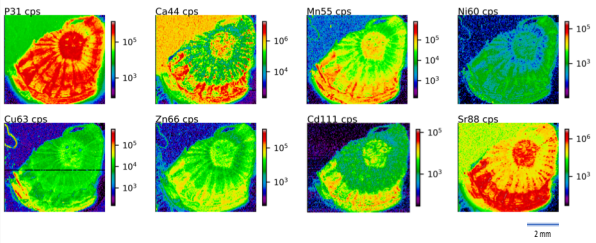


U/Pb in zircon, monazite and carbonates dating by LA-QQQ-ICP-MS

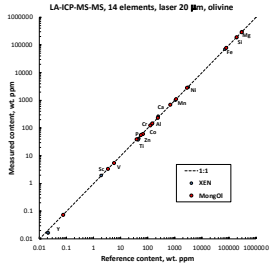


Bio-medical applications: LA-QQQ-ICP-MS imaging

Cacao branch, laser beam 38 µm in diameter



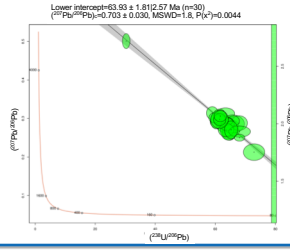
Trace elements in minerals and glasses LA-QQQ-ICP-MS

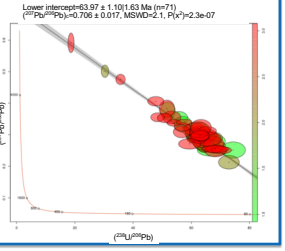


Reference carbonate Duff Brown Tank, age **64.01 ± 0.67** (isotope dilution by Hill et al, 2016).

Single session mean age **63.98 ± 2.57** (n=30)

Three sessions mean age **63.97 ± 1.63** (n=71)



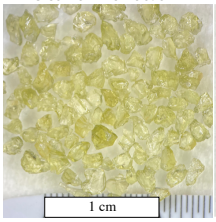


Planned : Hf isotopes in zircons, non traditional isotope systems Mg, Si, Fe, Ni in olivine and other minerals; Zr, Si in zircons and etc. Development of new matrix matched reference materials for EPMA and LA-ICP-MS. LIBS ?

Sample preparation for EPMA and LA-ICP-MS

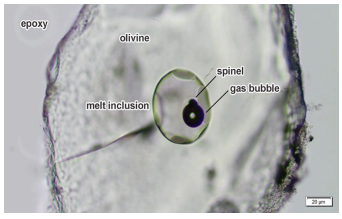
• Optical microscopes transmitted / reflected / polarized lights: Zeiss Azioscope 5POL 2.5X, 5X, 10X, 20X, 50X, 100X digital camera DELTAPIX 20 MP; Olympus BX 51 Microscope digital camera UC30 ; 3 stereo zoom Olympus SZ51/4 • 2 Grinding Polishing machine Buehler MetaServ 250 • Castn'Vac • Carbon coaters: Quorum Q150TE and Lieca EM ACE 600

Clean olivine fraction



Olivine mounted in epoxy

Melt inclusions in olivine



Laboratory equipment is designed for: manual mineral separation under optical control; epoxy coating; manual preparation of polished epoxy mounts for EPMA and LA-ICP-MS; exposing melt inclusions on the sample surface for EPMA, RAMAN and LA-ICP-MS; carbon coating for EPMA and electron microscope

IMAP Weakness: Shortage of permanent technical staff: no one in LA-ICP-MS and sample preparation

UGA Université Grenoble Alpes · cnrs · Université Savoie Mont Blanc · IRD Institut de Recherche pour le Développement France · Université Gustave Eiffel

fédération OSUG