Introduction
The Earth’s crust has been shaped as result of the chemical differentiation processes behind the phenomena of magmatism and formation of igneous rocks, and the transformation of rocks by metamorphism. Magmatism and metamorphism are key to understand how the lithosphere dynamics and Earth’s plate tectonics system work. New oceanic crust is formed by melting of the mantle at spreading ocean ridges. As this newly formed crust ages and gets transformed by metamorphism, it becomes denser, collapsing and sinking into the mantle forming a subduction zone. New continental crust is formed in the volcanic arcs above subduction zones by flux melting of the down-going plate and the overlying mantle, generating new magmas that form a felsic, buoyant, and thicker continental crust. Subduction zones are destructive plate margins where oceans are being consumed leading to the collision of continental crust and the formation of orogenic belts. As a group, we are interested in these igneous and metamorphic processes and their fundamental role in shaping the dynamics of Earth’s lithosphere.

We have an extensive experience mapping metamorphic and igneous complexes in the Iberian Massif and overseas (e.g. Caribbean orogen, Angolan craton); and bridging fieldwork with detailed petrological and geochemical studies and instrumental analytical work. Our group is formed by scientist that belonged to the former Geology and Geophysics and the Analytical Laboratories units of IGME. Our common interest is the use of petrological tools and analytical instrumentation to decipher the geological evolution and architecture of the Earth´s crust studying the texture, mineral and chemical composition of igneous and metamorphic rocks.

Group background, expertise and research lines
Five members, four researchers and one technical specialist in geology, all holding Ph.D´s, currently form our group. We are a trace element analyst and four geologists, one of them a U-Pb geochronologist, with a background in igneous and metamorphic petrology. We carry out work in igneous and metamorphic complexes, coupling geological mapping with structural geology and petrological studies. We have experience with geochronology, mineral thermobarometry (TWEQU and Domino multiequilibria calculation and pseudosection work using PERPLEX), petrofabric studies and determination of P-T-t-d trajectories of metamorphic rocks, geochemical modelling of igneous petrogenetic processes, and trace element and isotopic fingerprinting of mantle and crustal magma sources.

Our members, P. Valverde Vaquero and M. Castillo Carrión, work at the geochemical laboratories of IGME in Tres Cantos and have expertise in U-Pb ID-TIMS geochronology (P.Valverde Vaquero ) and trace element analysis by ICPMS (M.Castillo Carrión). We share clean-laboratory space where we have a Millipore water distillation system to produce ultrapure water and two separate Teflon sub-boiling distillation systems to produce ultrapure acids. The U-Pb geochronology laboratory has its own clean room space with class 100 fume hoods and an additional Mattison Teflon distillation system. Two spikes, a 208Pb-235U and a triple 205Pb-
233U-235U spike, are used for isotope dilution (ID), and a Triton multicollector thermal-ionization mass spectrometer (TIMS) is used for isotope ratio measurement. The laboratory routine dates different U-Pb geochronometers such as: zircon, monazite, xenotime, titanite or rutile. The spikes have been calibrated in the Earthtime interlaboratory experiment and Earthtime artificial solution are routinely used to check that accuracy and precision stay at 0.1%. The ICPMS laboratory does analyses of ultratrace elements in different geological matrixes ranging from natural waters and mine drainages to solid minerals and rocks. For solids, different sample digestion methods are used. Trace elements such as Rare Earths (REE’s) or Platinoid group elements (PGE’s) are analysed. The ICPMS laboratory is accredited by ENAC for mineral water analysis and participates in GeoPT interlaboratory experiments of the International Association of Geoanalysts (IAG) to assure accuracy and precision. As part of our group’s research interest, a special emphasis has been put in the analyses of the HFSE (Zr, Hf, Nb and Ta) in different types of rocks, and in carrying out in-situ trace element analyses in pyroxene, olivine and plagioclase using a 266nm CETAC Nd YAG solid-state laser system. The laboratory is currently equipped with two Agilent ICPMS instruments, a 7500 CE and a recently installed 7900 ICPMS. A new NWR 193 nm excimer (ArF) laser ablation system is going to be installed soon, which will open the capabilities of the laboratory to carry in-situ U-Pb LA-ICPMS dating and trace element analyses in different matrixes with spots down to 5 microns. As part of the analytical laboratories of IGME, we provide these techniques to internal and external users.

Most of our work has been done in igneous and metamorphic complexes in the Iberian Massif (Spain) and abroad. We have worked on the pre-Variscan and Variscan tectonothermal and magmatic events in the Iberian Massif. Overseas, we have been working in the Caribbean orogen for more than a decade, in different igneous and high-pressure metamorphic complexes of the Dominican Republic, carrying on the work initiated by IGME with the SYSMIN mapping project (see. Spec. Vol. “Geología y Minería de la República Dominicana”, Bol. Geol. Min. IGME, vol.128, Escuder-Viruete et al. (eds), 2017). This has been of our interest, as the arc-continent collision of the Caribbean arc with the North American continental plate provides some of the best exposures in the world of the different elements that make up a volcanic arc and the associated subduction zone. Since 2015, we have been involved in the PLANAGEO geological mapping of Angola, working with rocks ranging in age from 1.37 to 2.7 Ga, which has open our interest in the Proterozoic and Archean geodynamics of the lithosphere.

As a group, we have the following interests:

1) The formation of the oceanic crust (ophiolites) and the continental crust, the resulting mantle compositional heterogeneities, the igneous processes governing these processes, (e.g. boninitic cumulates of the Rio Boba plutonic complex, Dominican Republic; Escuder-Viruete et al., 2022, G3, 23, e2021GC010101).

2) The studying of the metamorphic reactions, deformation and the rock-fluid interactions that take place during subduction (e.g. Siuna Serpentinite Melange, Nicaragua; Escuder-Viruete et al., 2019, Lithos, v.340, 1-19) and the architecture of the modern Caribbean volcanic arc (Escuder-Viruete et al., 2020, Tectonophysics v. 796, 228631).

3) Petrochronology, dating geological events through the integration of U-Pb geochronology (ID-TIMS) of different thermochronometers (zircon, monazite, xenotime, titanite, rutile) with petrological and textural studies. In-situ trace element analyses by LA-ICPMS to characterize the elemental and isotopic composition of crystals, fluids and magmas.

4) The tectonothermal, metamorphic, and magmatic evolution of crystalline basements and orogenic hinterlands of collisional orogens. Proterozoic and Archean tectonics: magmatism, deformation, sedimentation and partial melting and reworking of the Angolan Shield (PLANAGEO project). Modern collisional orogens, Variscan belt: magmatism, tectonothermal
events and sediment provenance studies (e.g. Gonzalez-Clavijo et al., 2021, Solid Earth, 12-4, 835-867).

5) Mineral Systems and tectonics: formation of mineral deposits and their host magmatic systems in subduction zones and their remobilization during metamorphism (e.g.; ophiolites of the Caribbean orogeny and the Andean cordillera). Mineralization, new mineral U-Pb thermochronometers (U-Pb dating of wolframite and columbite-tantalite) and ICPMS analyses of PGE’s (Platinoids) and HFSE’s (Nb,Ta, Zr, Hf).

Group background, expertise and research lines
During the 2017-2022 period, we have published 23 scientific paper in SCI journals, with 10 papers in the Q1 category. We have done 10 scientific communications and 12 invited talks. We have produced 20 geological maps, at 1:50,000, 1:100,000 and 1:250,000 scales and compilations maps at to 1:500,000 and 1:1,000,000 scale for PLANAGEO, plus 21 scientific/technical reports and 5 book reports. We have participated in nine projects, leading four of them: one from the Plan Nacional de I+D+I and three international technology transfer projects, in the Dominican Republic and Angola.

We have one active project from Programa Retos, Plan Nacional de I+D+I, Project MISYAP: Recursos minerales en la litosfera de arcos volcánicos intra-oceánicos: procesos geodinámicos, evolución tectono-magmática y arquitectura corteza-manto (Ref. PID2019-105625RB-C22). The project líder (IP) is J. Escuder-Viruete and the participants are P. Valverde Vaquero (full time) and M. Castillo-Carrion (1/2 time), duration 2020-2024.

In the Dominican Republic, collaborating with the Servicio Geológico Nacional (SGN) and with founding from the Fondo Nacional de Innovación y Desarrollo Científico y Tecnológico (FONDOCTY; Ministerio de Educación Superior, Ciencia y Tecnología ,MESCyT) , J. Escuder Viruete has co-lead the Project “Geodinámica, Neotectónica, Sismotectónica y Tectónica activa en la Cordillera Septentrional de la República Dominicana” (Ref. 2015-1B3-118, Project leaders: Yésica H. Pérez Alejandro (SGN) and J. Escuder-Viruete; 2016 to 2018, extended to 2021) and is currently involved with the Project “ La amenaza de movimientos en masa en la República Dominicana: factores desencadenantes e implicaciones en la vulnerabilidad y gestión del riesgo” (Ref. 2018-19-1A4-008; Project leaders: Maria Betania Roque (SGN) and J. Escuder-Viruete; duration 2020-2022)

In Angola, we have participated in leading roles in the PLANAGEO project (Plan Nacional de Cartografía Geológica de Angola) financed by el Angolan Government. This project done as part of the UTE PLANAGEO partnership formed by LNEG (Portuguese Geological Survey), IGME and Impulso S.A. to provide new 1:250k and 1:100k geophysical and geological maps for Angola’s Geological Institute (IGEO). Participation: Geological mapping project leader J. Escuder-Viruete (2015-2019), E. Merino Martinez (2019-present); geochronology manager: P. Valverde-Vaquero (2015-present).

In non-leading roles, the group members have participated in the following technology transfer project: “Evaluación metalogenética y estudio geológico-estructural del distrito polimetálico San Antonio de los Cobres, provincias de Salta y Jujuy, República Argentina”. Finance: Convenio de cooperación y asistencia técnica en materia de geología y minería (de 11/09/2013) between the Argentinian Geological Service (SEGEMAR) and IGME (IGME Project leader: Nemesio Heredia Carballo, participant, J. Escuder-Viruete; duration 2018-2019).

Members of our group have also participated in the following EU-funded projects: FRAME “Forecasting and Assessing Europe’s Strategic Raw Materials Needs” Project Ref: GeoE.171.010; 2018-2021, Workpackage 6, Conflict free Nb-Ta for the EU. (IGME Project líder: Susana Timón; Participant: P.Valverde Vaquero); and CO2 Geological Pilots in Strategic Territories –