**Job Description**

The ExMODE group of the Instituto de Geociencias (CSIC-UCM, Madrid) offers a PhD candidate position (4 years) for research on the relationships between intrusive rocks, IOCG and magnetite-(apatite) mineralized systems with special focus on the ore deposits in the central Andes. The research will be conducted within the NanoMET (Nanometallogeny of critical metals with high technological value) project, coordinated by the IACT (CSIC) and funded by the Spanish Agencia Española de Investigación and the European Commission (project PID2022-138768OB-I00). Research will be done in close collaboration with companies currently exploring or mining the area.

**Tasks**

Within the NanoMET project, the candidate will focus his training and research plan to the geological, geochemical and geochronological comparison between the different styles of mineralization in the Coastal Cordillera (Mesozoic) and High Andes (Cenozoic) of Argentina, Peru and Chile. Main topics of the research plan include the following objectives: (1) High precision geochronology and radiogenic isotope geochemistry of ores and associated rocks; (2) Numerical modeling of aqueous fluid and melt flow and fluid-rock interaction; and, (3) High resolution study of mineral, melt and fluid inclusions. Analytical work will be partially done in research institutions in Canada and Europe and funded by several, already running, EU funded projects. The contract includes a specific budget oriented to fund training in external laboratories.

**Requirements**

Candidates must have a degree in Geology (or closely related disciplines) and more than 300 ECTS (European Credit Transfer and Accumulation System) or equivalent. A master in disciplines related to the geology and exploration of ore deposits is desirable. A high level in the English language and a driving license are compulsory requirements. Desired qualifications include a basic knowledge in drillcore logging, experience in writing technical reports or papers and previous presentation in conferences.

The candidate should have availability to travel to do field work in remote areas and attend project meetings and conferences.

We would be grateful if you would make this information available to members of your staff and others who might be interested via your normal internal procedure.

Should you have any questions, please do not hesitate to contact the Fernando Tornos at f.tornos@csic.es

**Appointment**

Predoctoral researchers at the CSIC hold a 4 years full time contract. Salary established by the Spanish Administration will increase from 1260.84 €/month the first year to 1,688.62 € the last year (12 payments. Benefits include the payment of the costs of the Doctorate studies and short stays in other R+D institutions.

Starting date: To be announced but likely before end of 2023.

Pre-doctoral researcher will be based at the Instituto de Geociencias (CSIC-UCM), in the campus of the Universidad Complutense de Madrid.

Candidates should be already accepted in Doctorate Program prior to the submission of their expression of interest – contact for advice.

Non-EU-candidates can apply for the contract and the only requirement is that they are legally in Spain – even with a tourist visa, if needed. See <https://edoctorado.ucm.es/faq-admision> and <https://www.aei.gob.es/noticias/nota-informativa-condiciones-incorporacion-personas-nacionalidad-extranjera-contratos#_edn1>

**Application**

Interested candidates must seek for this project in the page <https://www.csic.es/es/formacion-y-empleo/oportunidades-para-la-carrera-investigadora>

*Fields for the search:*

*Area: Vida*

*Instituto: “IACT” or “IGEO”*

*Modalidad: “Ayudas para contratos predoctorales para la formación de doctores (antiguas FPI)”*

From the list select: “Project PID2022-138768OB-I00 Nanometallogeny of critical metals with high technological value”

Upload the necessary information. The call will open in presumably in October 2023.

Online interviews will be organized with the selected candidates.

Recent publications of the Research Group (2020-)

Alcalde J, Carbonell R, Pospiech S, Gil A, Bullock LA, Tornos F (2022) Preface: State of the art in mineral exploration. Solid Earth 13:1161-1168. doi: 10.5194/se-13-1161-2022.

Amils R, Escudero C, Oggerin M, Puente Sánchez F, Arce Rodríguez A, Fernández Remolar D, Rodríguez N, García Villadangos M, Sanz JL, Briones C, Sánchez-Román M, Gómez F, Leandro T, Moreno-Paz M, Prieto-Ballesteros O, Molina A, Tornos F, Sánchez-Andrea I, Timmis K, Pieper DH, Parro V (2023) Coupled C, H, N, S and Fe biogeochemical cycles operating in the continental deep subsurface of the Iberian Pyrite Belt. Environmental Microbiology 25:428-453. doi: https://doi.org/10.1111/1462-2920.16291.

Bain WM, Steele-MacInnis M, Tornos F, Hanchar JM, Creaser EC, Pietruszka DK (2021) Evidence for iron-rich sulfate melt during magnetite(-apatite) mineralization at El Laco, Chile. Geology 49:1044–1048. doi: 10.1130/G48861.1.

Bouhier V, Franchini M, Tornos F, Rainoldi AL, Patrier P, Beaufort D, Boyce AJ, Pratt W, Impiccini A (2023) Genesis of the Loma Galena Pb-Ag Deposit, Navidad District, Patagonia, Argentina: A Unique Epithermal System Capped by an Anoxic Lake. Economic Geology 118:433-457.

Carriedo J, Tornos F, Chiaradia M, Galindo C (2021) A genetic link between albitic magmas and IOCG mineralization in the Ossa Morena Zone (SW Iberia). Journal of Iberian Geology 47:85-119. doi: 10.1007/s41513-021-00162-3.

Conde C, Tornos F (2020) Geochemistry and architecture of the host sequence of the massive sulfides in the northern Iberian Pyrite Belt. Ore Geology Reviews 127:103042. doi: https://doi.org/10.1016/j.oregeorev.2019.103042.

Conde C, Tornos F, Danyushevsky LV, Large R (2021) Laser ablation-ICPMS analysis of trace elements in pyrite from the Tharsis massive sulphide deposit, Iberian Pyrite Belt (Spain). Journal of Iberian Geology 47:429-440. doi: 10.1007/s41513-020-00161-w.

de Mello CR, Tornos F, Conde C, Tassinari CCG, Farci A, Vega R (2022) Geology, Geochemistry, and Geochronology of the Giant Rio Tinto VMS Deposit, Iberian Pyrite Belt, Spain. Economic Geology 117:1149-1177. doi: 10.5382/econgeo.4907.

Gisbert G, Tornos F, Losantos E, Pons JM, Videira JC (2021) Vectors to ore in replacive volcanogenic massive sulfide (VMS) deposits of the northern Iberian Pyrite Belt: mineral zoning, whole rock geochemistry, and application of portable X-ray fluorescence. Solid Earth 12:1931-1966. doi: 10.5194/se-12-1931-2021.

González-Jiménez JM, Piña R, Kerestedjian TN, Gervilla F, Borrajo I, Pablo JF-d, Proenza JA, Tornos F, Roqué J, Nieto F (2021) Mechanisms for PdAu enrichment in porphyry-epithermal ores of the Elatsite deposit, Bulgaria. Journal of Geochemical Exploration 220:106664. doi: https://doi.org/10.1016/j.gexplo.2020.106664.

González-Pérez I, González-Jiménez JM, Gervilla F, Fanlo I, Tornos F, Colás V, Arranz E, Hanchar J, del Mar Abad-Ortega M, Moreno-Abril AJ, Carrión M, Noval S (2022) Genesis and evolution of the San Manuel iron skarn deposit (Betic Cordillera, SW Spain). Ore Geology Reviews 141:104657. doi: https://doi.org/10.1016/j.oregeorev.2021.104657.

Keller T, Tornos F, Hanchar JM, Pietruszka DK, Soldati A, Dingwell DB, Suckale J (2022) Genetic model of the El Laco magnetite-apatite deposits by extrusion of iron-rich melt. Nature Communications 13:6114. doi: https://doi.org/10.1038/s41467-022-33302-z.

La Rosa RD, Khodadadzadeh M, Tusa L, Kirsch M, Gisbert G, Tornos F, Tolosana-Delgado R, Gloaguen R (2021) Mineral quantification at deposit scale using drill-core hyperspectral data: a case study in the Iberian Pyrite Belt. Ore Geology Reviews:104514. doi: https://doi.org/10.1016/j.oregeorev.2021.104514.

Levresse G, Tornos F, Velasco F, Corona-Esquivel R (2020) Subaerial explosive deposition of magnetite-apatite mineralization: The Artillero deposit, Peña Colorada district, Colima, Mexico. Ore Geology Reviews 126:103736. doi: https://doi.org/10.1016/j.oregeorev.2020.103736.

Mateo L, Tornos F, Hanchar JM, Villa IM, Stein HJ, Delgado A (2023) The Montecristo mining district, northern Chile: the relationship between vein-like magnetite-(apatite) and iron oxide-copper–gold deposits. Mineralium Deposita. doi: 10.1007/s00126-023-01172-0.

Pietruszka DK, Hanchar JM, Tornos F, Wirth R, Graham N, Severin K, Velasco F, Steele-MacInnis M, Bain WM (2023) Magmatic immiscibility and the origin of magnetite-(apatite) iron deposits. Research Square. doi: https://doi.org/10.21203/rs.3.rs-2156064/v1.

Pietruszka DK, Tornos F, Hanchar JM, Whitehouse MJ, Velasco F (2023) Tracking the isotopic sources of immiscible melts at the enigmatic magnetite-(apatite) deposit El Laco, Chile, using Pb isotopes. Bulletin Geological Society America (in press).

Tornos F, Galindo C, Darbyshire F, Casquet C, Noble SR (2021) Isotope geochemistry, age, and origin of the magnetite-vonsenite mineralization of the Monchi Mine, SW Iberia. Journal of Iberian Geology 47:65-84. doi: 10.1007/s41513-020-00159-4.

Tornos F, Hanchar JM, Munizaga R, Velasco F, Galindo C (2021) The role of the subducting slab and melt crystallization in the formation of magnetite-(apatite) systems, Coastal Cordillera of Chile. Mineralium Deposita 56:253-278. doi: 10.1007/s00126-020-00959-9.

Tornos F, Hanchar JM, Steele-MacInnis M, Crespo E, Kamenetsky V, Casquet C (in press) The formation of magnetite-(apatite) systems by crystallizing iron-rich ultrabasic melt and separating slag. Mineralium Deposita.

Velasco F, de la Pinta N, Tornos F, Briezewski T, Larrañaga A (2020) The relationship between destinezite to acid sulfate alteration at the El laco magnetite deposit, Chile. American Mineralogist 105:860–872. doi: https://doi.org/10.2138/am-2020-7122.

Verdugo-Ihl MR, Ciobanu CL, Courtney-Davies L, Cook NJ, Slattery A, Ehrig K, Tornos F, Hanchar JM (2022) U-Pb geochronology and mineralogy of hematite from Mantoverde and Carmen de Cobre, northern Chile: Constraints on Andean IOCG mineralization. Economic Geology 117:943-960.

**Historial científico técnico**

The ExMODE group has worked for more than ten years in research on the genesis and exploration of ore deposits, with special emphasis in critical metals. Our research includes the study of different types of mineralization with special emphasis in volcanogenic massive sulfides (VMS), skarns and magnetite-(apatite) and IOCG styles in Iberia and South America. Our studies in mineral systems cover a broad range of disciplines including field geology, petrography, geochemistry (lithogeochemistry and stable and radiogenic isotopes), geochronology and numerical modeling. Most of our recent research is funded by European Union Projects (PROMINE, iTarg3t, EIS and AGEMERA, between many others), Spain-funded ones and consulting with mining and exploration companies.

Our in-house analytical facilities, include microscopes, sample preparation, stable isotopes, CL and microthermometry. Facilities within the campus include EPMA, SEM and different types of electron microscopes, radiogenic isotopes, RAMAN spectrometers and LIBS. Other research centers of the CSIC have other complementary techniques including SHRIMP, LA ICPMS, and unconventional stable isotopes.