Short Activities Report

Advanced training to the appointed MSc research fellow

(March 21, 2022 to April 20, 2023)

Project: Predictive models for strategic metal rich, granite-related ore systems based on mineral and geochemical fingerprints and footprints (FCT ERA-MIN/0005/2019 MOSTMEG

Nuno Grácio

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1 Introduction

The activities described in this report were performed by the grant holder within the MOSTMEG Project - *Predictive models for strategic metal rich, granite-related ore systems based on mineral and geochemical fingerprints and footprints*- ERA-MIN Joint Call 2019 (FCT ERA-MIN/0005/2019), from March 21, 2022 to April 20, 2023, 30 days before the end of the Research Grant (May 20, 2023; 14 months; Edital nº14 URMG) as required, accompanying the request of the grant extension.

The activities were carried out in the scope of WP4 "Mineral Fingerprint and Footprints", Task 4.3 "*Reassessment of alluvial heavy minerals from old exploration surveys"*, according to the work plan of the Research Grant (Edital nº14 URMG). The focus was the mineralogical and chemical study of heavy minerals (HM) of the Segura region (Castelo Branco). The objectives of this task are to re-evaluate alluvial heavy minerals from former exploration surveys and find useful mineral pathfinders and fingerprints as a tool for Sn and W deposits exploration. As pointed in the MOSTMEG Transnational Proposal, the main goal of Task 4.3, *is the Re-examination of alluvial heavy minerals from old exploration surveys to evaluate the spatial extent of some mineral fingerprints/footprints and their usefulness in regional exploration strategies*. Moreover, in this sense, it is intended: (i) *the recognition and chemical characterization of mineral phases of higher relevance to the issues of interest among those forming the picked heavy mineral associations*. (ii) *the evaluation of the impact of potential mixing effects documenting signals from distinct sources (how should we process/filter them?)*; and (iii) *the relative abundance above which a certain mineral fingerprint or a given "proxy's assemblage" is reliable.* To reach the objectives, the minerals selected to be the focus in this study were the Sn-W ore minerals, i.e., cassiterite, wolframite and scheelite, TiO_2 polymorphs, i.e., rutile, anatase and brookite, and tourmaline; additionally garnet raised interest for the study. The activities of the research grant were mainly performed at LNEG Alfragide facilities under the supervision of Dr. Rute Salgueiro (Principal Investigator (PI) in MOSTMEG FCT ERA-MIN/0005/2019). Even so, as planned for this Task 4.3, there was scientific collaboration and support from Dr. Miguel Gaspar (FCUL; partner of the Transnational MOSTMEG Project). This interconnection of activities materialized also in the follow-up of the grant holder in the chemical analysis of mineral samples by electron microprobe at the FCUL facilities.

The preliminary results obtained, and its interpretation were discussed with the PI and the Task.4.3 team involved, and part was presented and discussed in the 2nd Annual Meeting and included in the

2nd Annual Progress Report of the Transnational MOSTMEG Project. Additionally, the grant holder is co-author of a scientific paper published in the journal *Minerals* and an abstract submitted to the Congresso Nacional de Geologia 2023.

Several activities are still under development, and are expected to be completed in the research grant time frame: 1) the update of the maps of the total number of grains of cassiterite, scheelite and wolframite, developed previously (in WP1) for Segura mining region are being improved aesthetically (e.g. matching the colors of the map patterns with the other maps produced in the Task 4.3) and some total number of grains values can also possibly be updated; 2) the development and, if possible, conclusion of the chemical analysis by EMP (at FCUL facilities, dependent on the possibilities of this partner´s) of the mineral mounts produced for the Polygon 1; 3) Complete the mineralogical study and handpicking independent of the chemical study/analysis that remains to be completed; 4) collaboration in the organization and interpretation of the results. In addition, an experimental work is carried out to determine the % of predefined mineral grain populations for cassiterite, rutile, anatase, brookite, tourmaline and garnet. These results are dependent of the evolution of this test.

1.1 Study area

The studied area is located in Segura (Castelo Branco), and it is included in the Central Iberian Zone (CIZ). The main lithologies outcropping in this region encompass metasedimentary rocks belonging to the Schist Greywacke Complex (SGC), granitic rocks belonging to the Segura Massif (Portuguese part of the Cabeza De Araya Batholith outcropping in Spain) and several types of mineralized veins (i.e., Sn-W Mineralized quartz veins; Sn-Li Mineralized aplite-pegmatite veins; W-Sn Mineralized quartz veins; Ba-Pb mineralized quartz veins). The different mineral Sn-W/W-Sn and Li-Sn occurrences in the study area were part of, in the past, the Segura Mining Camp, which belongs to the tin-tungsten metallogenic belt of Góis-Segura. For the present study, this area was subdivided in 2 main polygons, (Fig. 1, Table 1). In the Polygon 1 (Segura mining region) the priority area to study, the large, zoned NW-SE elliptic granitic body, mentioned above, outcrops in the Southern part of this study area, produced a spotted-schist contact halo of about 500 m in the Beira Group. At approximately 1.5 km from the Polygon 2 (Southern region of Segura), towards Spain, outcrops the Estorninos Granite, a 7 km long porphyroid granitic body which also produces a metamorphic contact halo in this polygon area. In association with this intrusive body there is also the presence of a mineralized Sn vein on the northern part of this granite (in Spain). Several other intrusive bodies outcrop in this polygon, namely quartz veins, lamprophyres and tonalite porphyries (Romão et al., 2010).

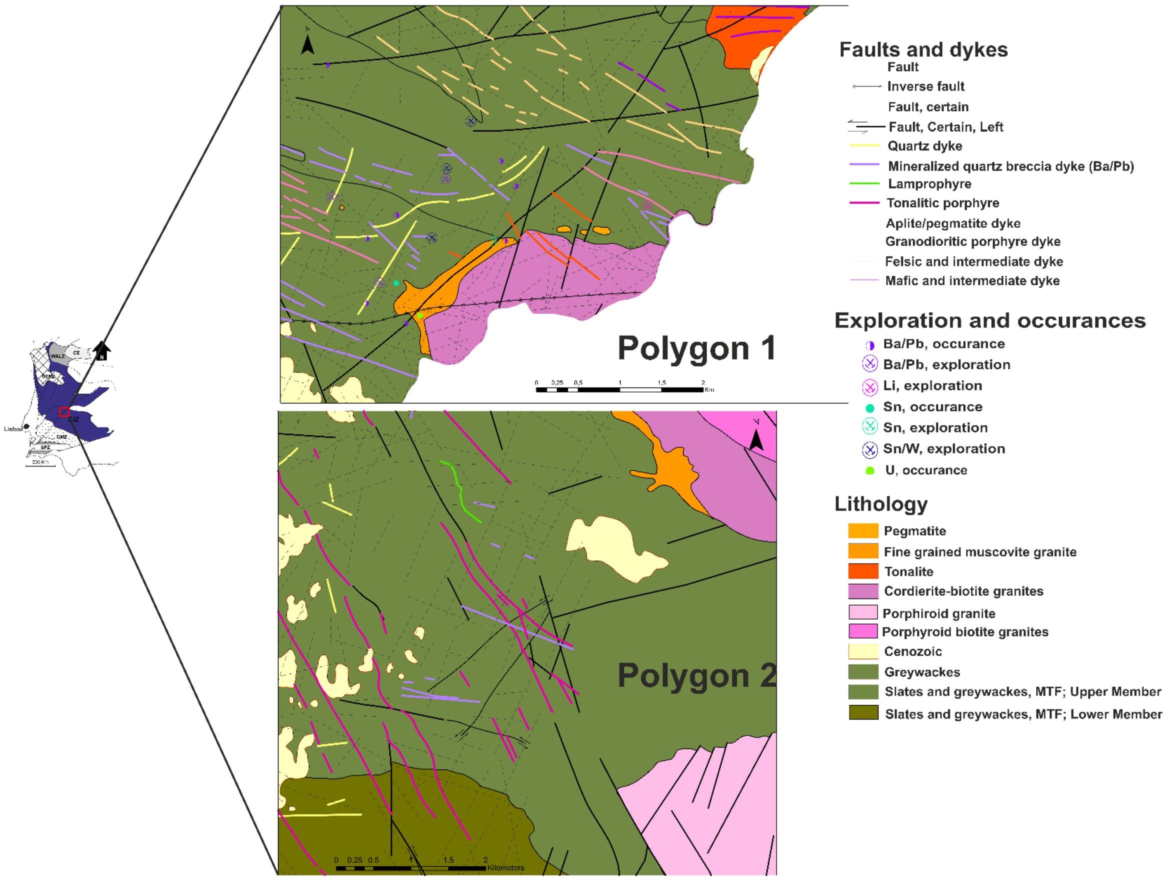


Fig. 1 Geological setting of the study area: Segura Mining region (Polygon 1); and Southern region of Segura (Polygon 2); plotted in an extract of the geological map produced by the MOSTMEG transnational project team.

2. Summary of the work developed under the framework of Task 4.3

2.1 Mineralogical analysis

Under the framework of the Task 4.3 (WP4) and its objectives, alluvial heavy minerals from, so far, 43 samples from Polygon 1 and 19 samples from Polygon 2 have been identified and characterized under binocular microscope, according to the work plan. Along this study stage, it was used the UV light for scheelite identification/characterization and tinning test for cassiterite identification in several samples; also, the hand magnet helped to differentiate mineral grains and microphotographs were taken. To verify their suitability in mineral exploration works, the physical properties (e.g., color, habit, size, pleochroism, zonation and inclusions) of the cassiterite, wolframite, scheelite, TiO_2 polymorphs and additionally garnet were analyzed using a binocular microscope, as initially implemented by the Principal Investigator (PI; MOSTMEG Project, part LNEG) in the first 22 studied samples from Polygon 1. The grant holder has collaborated in the development of this methodology and several mineral populations were identified and characterized and mineral standards for the different populations were made in collaboration with the PI.

2.2 Processing data

After identification, semi-quantitative analysis and statistical study of the different mineral species, the average percentage, and the distribution of each mineral in the total volume of the 65 samples of alluvial heavy minerals from Polygon 1 and 24 from Polygon 2 were determined with the aid of a specialized excel spreadsheet and the ArcGIS software (Table 1).

Table 1 – Geological setting of the different polygons of the study area, the number of samples studied and used in maps production, and mineral mounts from each one.

Polygon	Geological Setting	Nº samples Heavy mineral concentrates studied	N.º samples Mineral grains population studied	Mounts	N.º samples used for Mineral distribution maps
1a	Segura granite distal/proximal exocontact, granitic porphyry, mineralized quartz breccia, quartz and aplite-pegmatitic veins hosted in SGC rocks	15	15	CASS1, CASS2, RUT1, SCH1, Wlf1, GRT2	34 + 27 (this work + Grácio, 2020)
1b	Segura granite proximal exocontact, granitic porphyry, mineralized quartz breccia, quartz and aplite-pegmatitic veins hosted in SGC rocks,	28 (31)	28 (+4 for rutile populations)	RUT2, ANA2, CASS3, CASS4, SCH1, WLF1, GRT2	31+16 (This work + Grácio, 2020)
2a	Lamprophyres, tonalitic porphyry, quartz, and mineralized quartz breccia veins hosted in SGC rocks, Estorninos granite exocontact	19	Under development	Under development	Under development

For Polygon 1, after data processing, six studied samples were selected as representative of the mineral contribution from the different geological source to alluviums, i.e. Segura granite, SGC metasediments, Sn-W / W-Sn mineralized quartz veins, Sn-Li mineralized aplite-pegmatite veins and Ba-Pb mineralized quartz veins (Fig. 2).

With the aid of ArcGIS software six maps were produced, one for each mineral (i.e., cassiterite, tourmaline, rutile, anatase, brookite and garnet,) with the different populations of each mineral identified in the samples (Fig. 3) and other 6 maps with the pie chart size in relation to the % volume of the mineral in the sample.

The average percentage of cassiterite, tourmaline, TiO_2 polymorphs, wolframite, scheelite and garnet in the 65 samples of Polygon 1 were also used to produce regional distribution interpolation maps for each mineral, with the ArcGIS software using geostatistical tools for the interpolation maps. To strengthen the data of these maps, the average of these minerals in 43 samples from Grácio (2020) study was also used. The values of the average ratios of cassiterite, wolframite, scheelite, TiO_2 polymorphs and garnet from a total of (65 + 43) samples were projected onto mineral distribution maps allowing the visualization of the distribution of these minerals in the study area (Fig. 4).

2.3 Preparation of mineral mounts for chemical analysis

The separation and handpicking of 1221 grains of anatase, rutile, cassiterite, tourmaline, wolframite, scheelite and garnet, from different samples of Polygon 1, representing different populations, was carried out with the objective of analyzing these grains using electron microprobe (1136 analyses) and LA-ICP-MS (234 analyses, by FCUL partner) (Table 2). Therefore, 13 mineral mounts were made to be able to analyze these grains (Table 3).

Table 2 - General information about the mineral mounts produced in this project.

Mount	Minerals	Nº samples	Nº grains	Nº analyses (EMP)
ANA1	Anatase	7	101	209
ANA2	Anatase	9	91	
CASS1	Cassiterite (Rutile)	8	81(5)	250(9)
CASS2	Cassiterite (Rutile)	7	103 (2)	185(6)
CASS3	Cassiterite (rutile?)	7	74	
CASS4	Cassiterite (rutile?)	10	72	
GRT1	Garnet (ilmenite inclusions)	11	38(23)	130(68)
GRT2	Garnet	15	102	
RUT1	Rutile	7	105	
RUT2	Rutile	11	84	
SCH1	Scheelite	15	97	
TUR2	Tourmaline	11	142	279 + 234 (EMP + LA-ICP-MS-FCUL partner)
WLF1	Wolframite	14	101	

Table 3 - Samples from which the grains of each mounts were collected.

Mount	Samples
ANA1	295-62; 295-73; 295-468; 295-85; 283-510; 295-424; 283-478
ANA2	295-501; 295-448; 295-87: 295-116; 295-472; 295-469; 295-486; 295-519; 295-463
CASS1	295-423; 295-63; 295-468; 295-85; 295-423; 295-73; 283-478; 295-431; 283-510; 295-468
CASS2	283-485; 295-68; 295-83; 295-445; 283-506; 295-414
CASS3	295-477; 295-463; 295-482; 295-448; 295-463; 295-455; 295-479; 295-501
CASS4	295-510; 295-519; 295-87; 295-471; 295-486; 295-110; 295-115; 295-503; 295-508; 295-449
GRT1	295-63; 295-311; 295-312; 295-72; 295-323; 295-63; 295-429; 295-435; 295-423; 283-508; 283-484; 295-434
GRT2	295-511; 295-513; 295-110; 295-460; 295-490; 295-483; 295-87; 295-472; 295-61; 295-429; 295-435; 283-484; 295-519; 295-414
RUT1	295-79; 295-312; 295-435; 295-323; 295-430; 283-506; 283-478
RUT2	295-508; 295-510; 295-449; 295-460; 295-501; 295-490; 295-448; 295-479: 295-110; 295-471; 295-469
SCH1	295-477; 283-491; 295-466; 295-448; 295-115; 295-501: 295-417; 295-468; 295-414; 295-472; 295-471; 295-455; 295-510; 295-63; 295-482
TUR2	295-323; 295-72; 295-468; 295-430; 295-435; 283-508; 283-490; 283-484; 283-510; 295-63; 295-83
WLF1	295-79; 283-478; 295-424; 283-506; 295-73; 295-83; 295-61; 283-490; 283-510; 295-449; 295-510; 283-493; 295-85; 295-463

2.4 Chemical analysis

The EPMA analysis were performed with the grant holder monitorization, and with the coordination and assistance of FCUL partner, in FCUL facilities The EPMA chemical data processing, in excel, of all the minerals analyzed except for the garnets (by FCUL partner) was conducted by the grant holder. The chemical data generated were organized in different excel sheets for each mineral, and each analysis point is controlled (this means that in this geochemical database there is also the information about the type of grain, from which sample, if the analysis was made in the core or border, if the grain is zoned, the mount that it corresponds to the row, the number of the grain from that row and the from which type the grain is, if applicable) This data was then used to produce different geochemical discriminant diagrams for the different minerals (cassiterite, rutile, anatase, tourmaline and garnet) to aid and present our interpretation of the data obtained. The grant holder has updated the data treatment of the LA-ICP-MS tourmaline analysis (original data treatment interpretation performed by the FCUL partner) discriminating the different tourmaline types.

3. Preliminary Results

3.1 Heavy Mineral Analysis

In Table 4 are represented all the 33 minerals identified during the heavy mineral analysis and their average percentage in the total of the 65 samples of the Polygon 1; and in Table 5 are represented the 23 minerals identified, so far, during the heavy mineral analysis and their average percentage in the total of the 24 samples studied, so far, of the Polygon 2.

The abundance (average %) of the iron oxides-hydroxides (57.76 % - Polygon 1; 68.97 % - Polygon 2) stands out from the remaining minerals since they are present in practically all the samples and, generally, in significant quantities, while the remaining minerals can, although with lower average %, be quite abundant only in some samples. Of the minerals of interest for the present study, and regarding Sn and W ore minerals, cassiterite is more abundant than wolframite and scheelite (6.05 % - Polygon 1; 3.85 % - Polygon 2) in both Polygons and regarding the W ore minerals wolframite is the most abundant in the Polygon 1 (1.13 % - Polygon 1; 0.02 % - Polygon 2); however in the Polygon 2 scheelite is the dominant W ore mineral (0.20 % - Polygon 1; 1.19 % - Polygon 2).

Table 4 - Average percentage of each mineral in the total of the 65 samples of alluvial heavy minerals from the Polygon 1 of the Segura mining region. MGN-magnetic minerals fraction; NM-nonmagnetic mineral fraction.

Mineral	**% Average**	**Mineral**	**% Average**	**Mineral**	**% Average**
Iron Oxides	57.76	Biotite	0.52	Chlorite	0.02
Ilmenite	12.37	Topaz	0.48	Sulfides	0.02
Cassiterite	6.05	Zircon	0.43	Xenotime	0.01
Tourmaline	5.16	Leucoxene (MGN)	0.28	Pyrite	0.01
Baryte	3.68	Andalusite	0.28	Staurolite	0.01
Anatase	1.96	Brookite	0.23	Galena	0.01
Apatite	1.59	Scheelite	0.20	Sillimanite	0.01
Wolframite	1.13	Lym Pyrite	0.09	Epidote	0.01
Leucoxene (NM)	0.63	Gold	0.09	Monazite	0.01
		Siderite	0.06		
Rutile	0.56	Muscovite	0.06	Kyanite	<0.01
		Cinnabar	0.05		
				Nodular monazite	<0.01
Garnet	0.54	Columbo-Tantalite	0.02	Undifferentiated minerals	3.08
Total					**100.00**

Table 5 - Average percentage of each mineral in the total of the 24 samples of alluvial heavy minerals from the Polygon 2 of the Segura mining region. MGN-magnetic minerals fraction; NM-nonmagnetic mineral fraction.

Mineral	**% Average**	**Mineral**	**% Average**
Iron Oxides	68.97	Leucoxene (NM)	0.15
Ilmenite	13.26	Brookite	0.08
Cassiterite	3.85	Garnet	0.07
Zircon	3.48	Gold	0.04
Tourmaline	3.47	Cinnabar	0.03
Anatase	1.91	Brookite	0.23
Scheelite	1.19	Wolframite	0.02
Lym. Pyrite	0.53	Biotite	0.02
Rutile	0.49	Muscovite	0.01
Andaluzite	0.35	Apatite	<0.01
Baryte	0.26	Topaz	<0.01
		Sillimanite	<0.01
Total			**100**

It was also possible to observe that the heavy mineral associations identified mostly reflect the outcropping lithologies of their sampling location, including specific evidence of different types of mineralization. The samples collected in the area where the Segura Massif outcrops (295-312) typically show abundant tourmaline and some garnet, biotite, and muscovite, while the samples collected in the drainage areas where the SCG rocks outcrop (283-486), without direct influence of igneous or hydrothermal bodies, show mostly iron oxides-hydroxides and altered minerals (leucoxenes). In the proximal zones of Sn-W/Li-Sn, Ba-Pb ore veins and dykes it is common to find samples with relatively higher abundances of cassiterite (295-432) wolframite (283-506) and baryte (295-79), depending on the type or types of proximal mineralization (Fig.2).

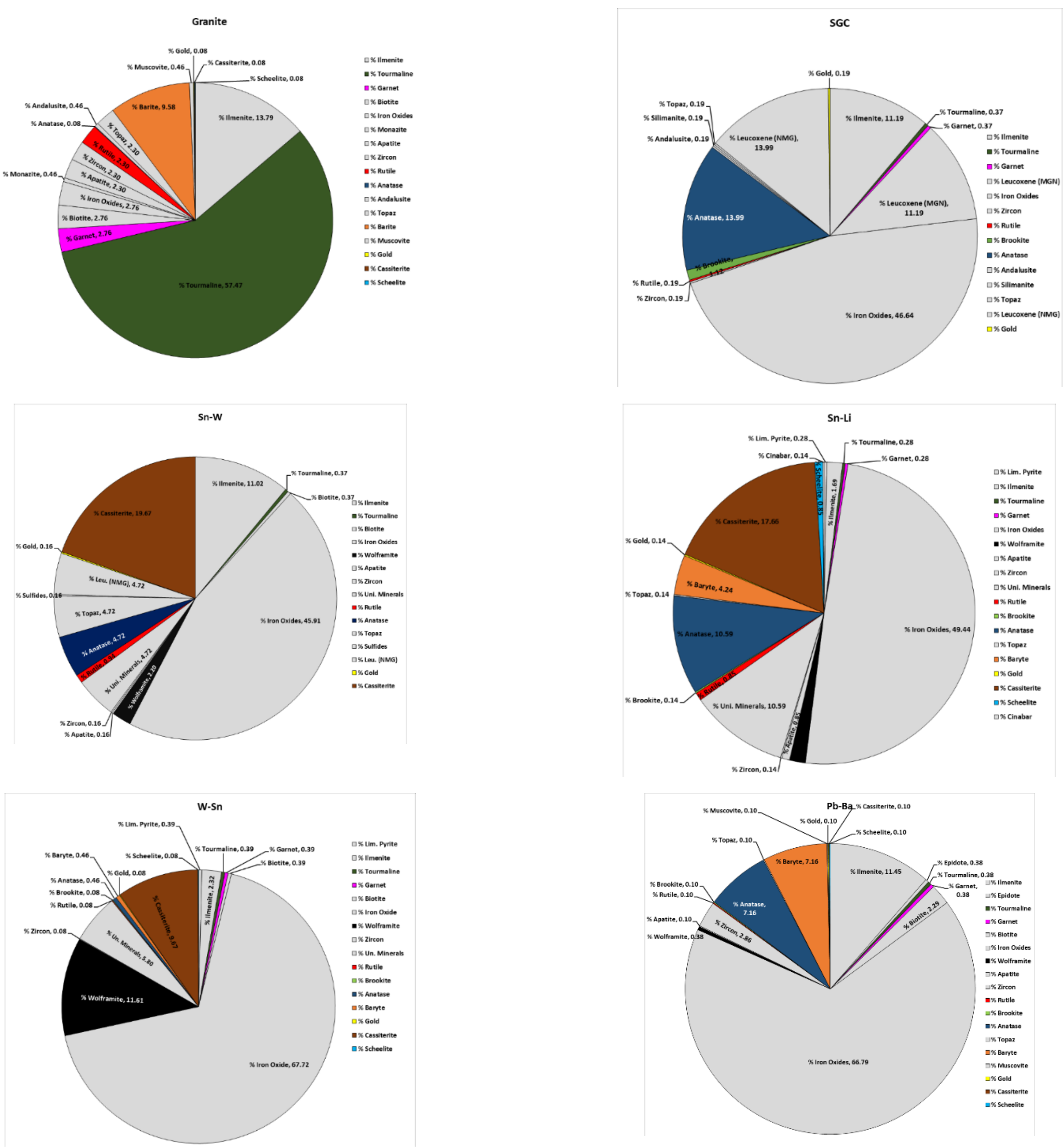


Fig. 2 - Pie charts of six samples as examples of alluvial heavy minerals of the Segura mining region (Polygon 1) collected in areas under the influence of the mineral contribution from specific lithologies to alluviums: 295-312 – Segura Granites;

283-486 – SGC Metasediments; 295-432 – Sn-W Mineralized quartz veins; 295-501 – Sn-Li Mineralized aplite-pegmatite veins; 283-506 – W-Sn Mineralized quartz veins; 295-79 – Ba-Pb mineralized quartz veins

As mentioned above, several cassiterite, tourmaline, garnet and Ti polymorphs grain populations were identified. In the Fig.3 is shown the different mineral populations present in the heavy mineral samples of the Polygon 1. As can be seen, cassiterite, tourmaline and rutile populations are more variable in the W side than in the E side samples of the study area.

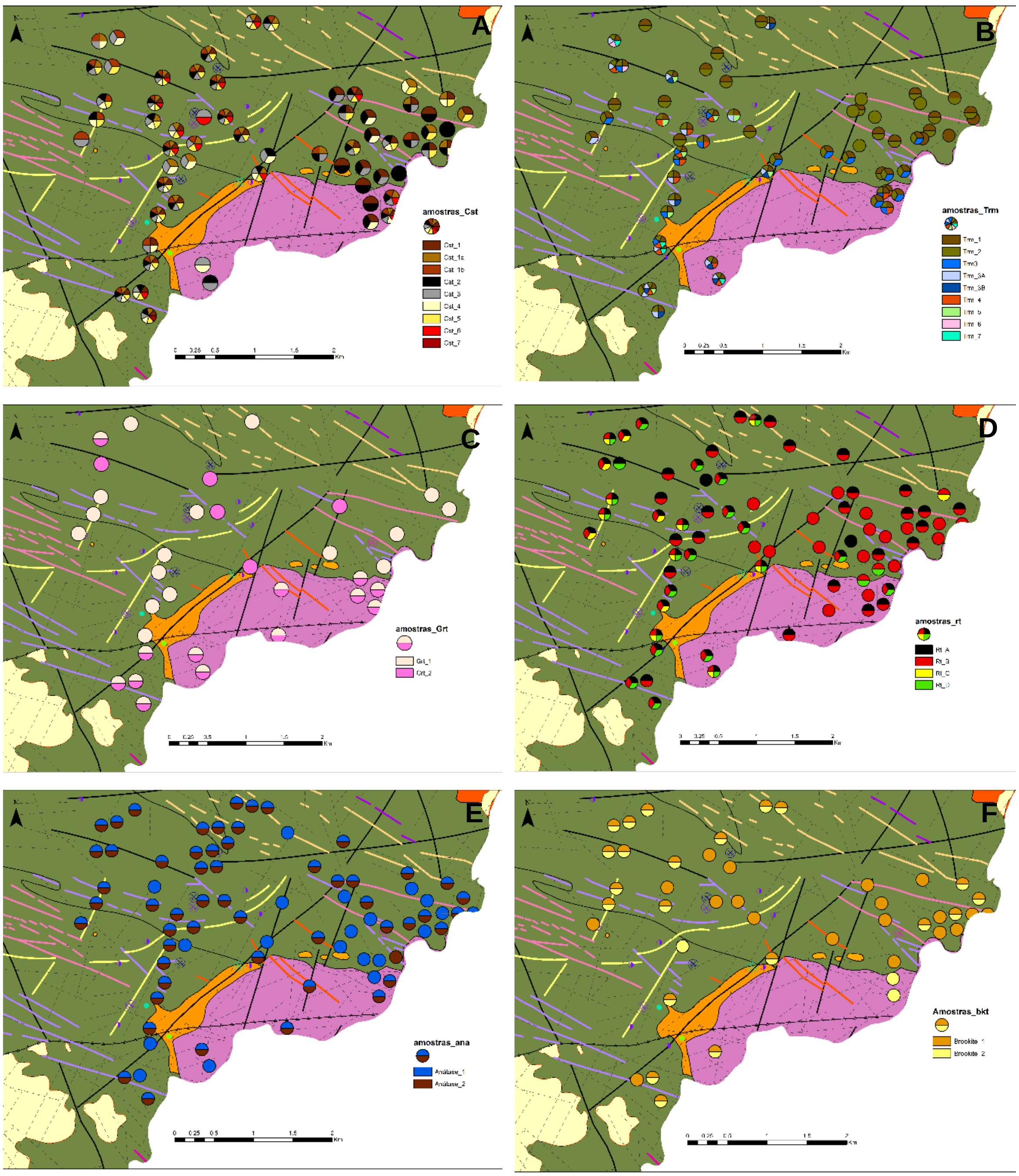


Fig. 3 – Regional distribution of the alluvial heavy mineral grain populations in Segura mining region (Polygon 1), plotted over the geological map produced under the scope and by the team of the MOSTMEG transnational project. Grain populations for: A) Cassiterite, defined mainly by color, diaphaneity and pleochroism; B) Tourmaline, defined by color; C) Garnet (Type 1: spessartine; Type 2: almandine); D) Rutile, defined by habit (Group A: prismatic; Group B: anhedral; Group C: acicular polycrystalline aggregates; Group D: bipyramidal and others undifferentiated); E) Anatase, defined by habit (Type 1: bipyramidal; Type 2: basal); F) Brookite, defined by color

3.2 Mineral distribution maps

In this section are presented the abundance distribution maps of the minerals of interest for this study, in the Polygon 1. The presence of cassiterite is ubiquitous in the area, with higher abundance near old exploration zones (see Fig. 1) and low abundance in granites of the Segura Massif (Fig 4 A). The alluvial wolframite becomes more abundant in the samples near the old mining works in W area of Polygon 1, three anomalies are identified, a northernmost one and two more anomalies aligned, approximately, NE-SW, in the area of the old exploration works (Fig. 4 B). Regarding the scheelite grains, their abundance is low, the samples with the more scheelite abundance are in the eastern area close to where the mineralized Sn-Li aplite-pegmatites outcrop (Fig 4 C; see Fig. 1). In regard to the rutile abundance distribution map, it is possible to identify two zones with anomalous abundances, one in the zone where the granite outcrops and the other to the N of the granites (see Fig. 1), separated by a zone where the abundance of rutile is lower (Fig. 4 D). Anatase is more abundant than rutile in this polygon, but it is also possible to identify two anomalous zones one on the W side and the other on the N side, despite some high values in the granite area (Fig. 4 E; see Fig. 1). The brookite was the least abundant mineral studied in the samples, however a zone of anomalous brookite abundance is identified on the NE side. In general, it is also possible to verify that both brookite and anatase abundances tend to increase with distance from the Segura massif (Fig. 4 F). Tourmaline is more abundant in the Segura Massif and its exocontact rocks sourced samples, compared to the off-granite samples and its abundance tends to decrease in the samples further away from this massif (Fig. 4 G). The garnet abundance is almost limited to the Segura Massif and its exocontact rocks, with very low abundances outside the granite influence and the maximum value of garnet was found in the samples collected near the muscovite granite outcrops (Fig.4 H; see Fig.1).

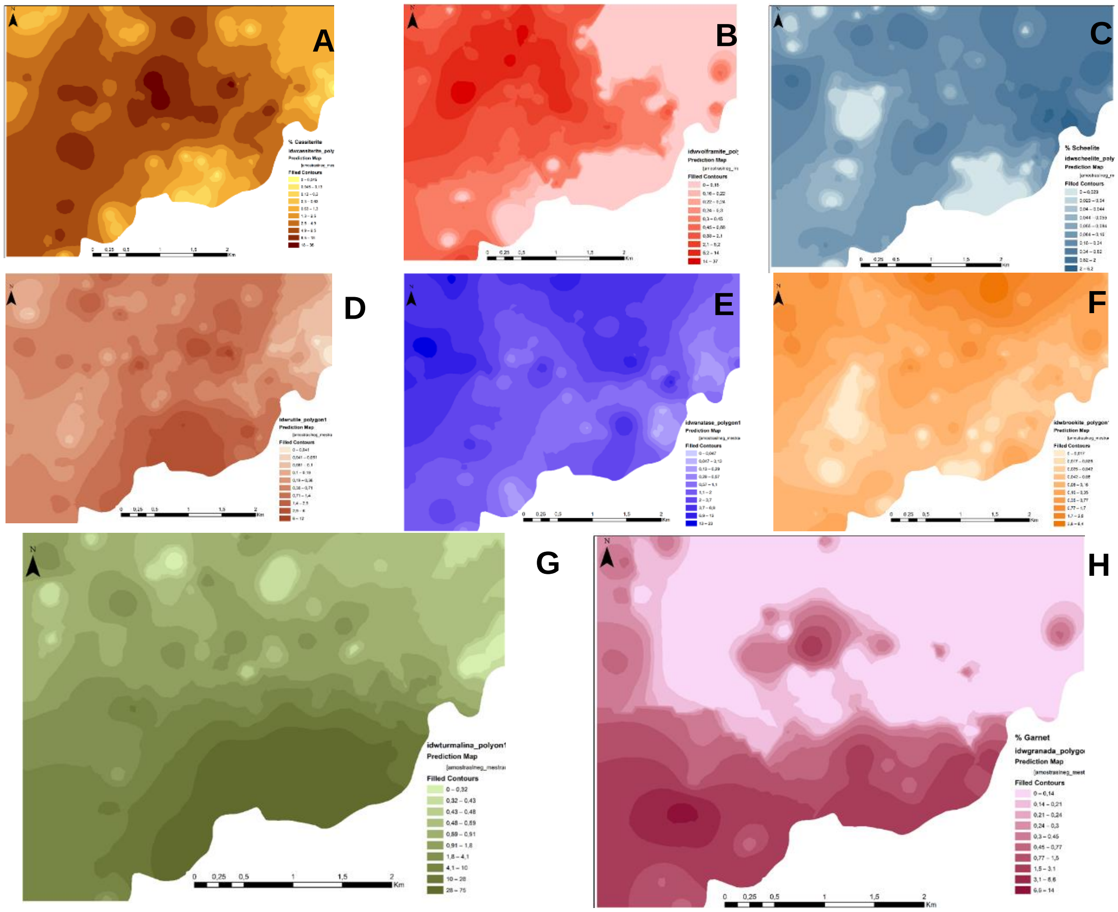


Fig. 4 – Mineral distribution of the abundance of mineral grains of the heavy mineral samples in the Polygon1. A Cassiterite; B) Wolframite; C) Scheelite; D) Rutile; E) Anatase; F) Brookite; G) Tourmaline; H) Garnet.

3.3 Mineral Chemistry

In comparison with the composition of the grains of cassiterites analyzed in the same region and presented by Grácio (2020), the cassiterites from the present study are, in general, similar, except for the maximum contents in W and Fe. The maximum value of WO_3 recorded in the grains of cassiterites studied for this work (5.29 %) is higher than the value of the cassiterite grains analyzed in Grácio (2020; i.e., 1.93%), the opposite happens with Fe (3.07 %, Grácio 2020; 0.74 % - this work). The composition of the cassiterites was projected on the triangular diagram (Sn+Ti)-(Nb+Ta)-(Fe+Mn)(Fig. 5) showing the existence of 2 distinct trends: a main trend that follows, in general, the columbo-tantalite substitution ($3Sn^{4+} = 2(Nb^{5+}, Ta^{5+}) + (Mn^{2+}, Fe^{2+})$); and also a trend that indicates an excess of Nb+Ta in the cassiterite structure, suggesting cationic voids and/or the presence of Nb+Ta in the tetravalent state. It is important to note that only the grains of Type 2 cassiterites present a geochemical signature that suggests some these substitutions.

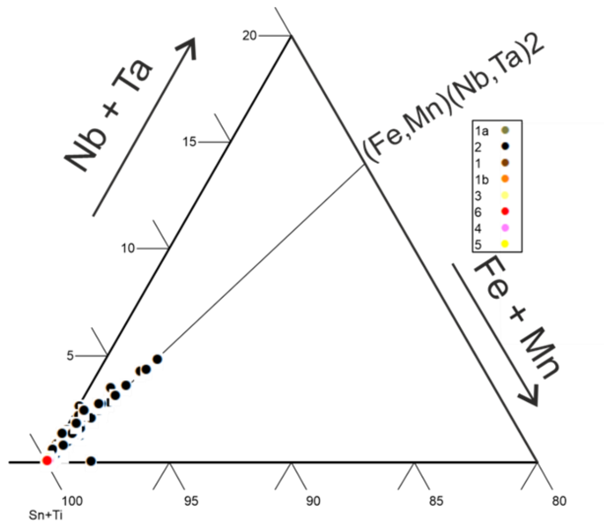


Fig. 5 - Projection of the different types of cassiterite grains analyzed in the samples of alluvial heavy minerals of the Segura mining region, in the triangular diagram (Nb+Ta)-(Sn+Ti)-(Fe+Mn).

Preliminary chemical data, obtained by LA-ICP-MS analysis (by FCUL MOSTMEG Partner), of alluvial tourmaline composition suggest the co-existence of 3 main compositional trends, Sn-enrichment, Sn+Li-enrichment and Li-enrichment (Fig. 6), creating reasonable expectations on their use as vectors to ore-forming systems, after an improved critical data analysis. The discrimination of the tourmaline types was now added by the grant holder to allow a better understanding of the results.

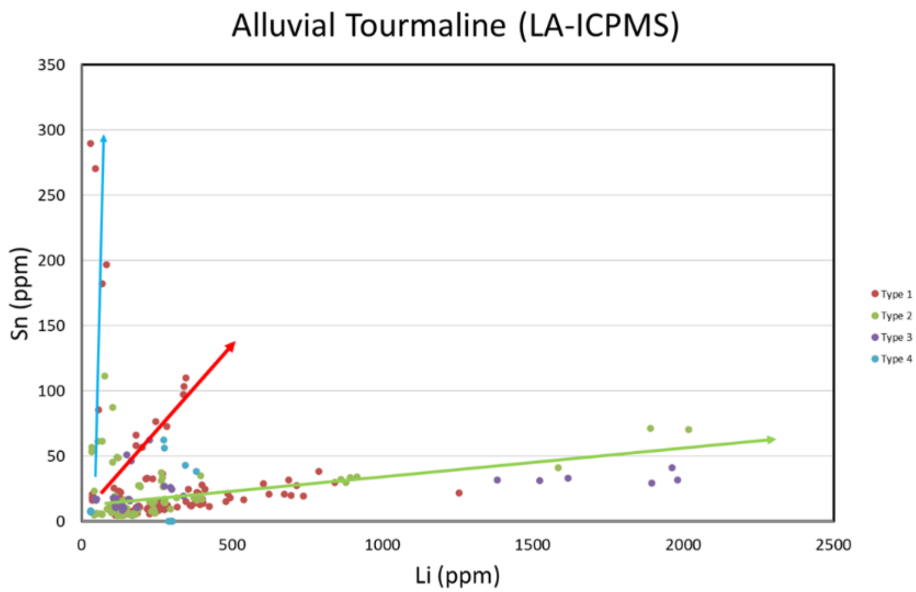


Fig. 6 - Sn vs Li diagram for alluvial tourmaline Types 1, 2, 3 and 4 from the Segura mining region (Polygon 1), showing the trends according to Sn-enrichment, Sn+Li-enrichment and Li-enrichment (updated from MOSTEMG 2nd Annual Progress Report).

The chemical compositions of rutile and anatase grains obtained in this work, although in smaller volume, are comparable to those presented in Grácio (2020) and Gaspar (2022) and continue to show that there are also signatures of mineralization in the anatase although of being in the rutile the greatest enrichment in trace elements. Except for V content in the anatases, and the average and median Nb content in the anatases, the trace element contents in the TiO_2 oxides analyzed in this work are slightly lower than those presented in Grácio (2020). In order to visualize the relationship of the rutile with base metal deposits and Au Clark and Williams-Jones (2004) developed a triangular discriminant diagram used to distinguish between rutile signatures of mineralized and non-mineralized samples, with the vertices defined by Ti concentration values, 100(Fe+Cr+V) and 1000(Sn+W), in atoms per unit formula (apfu) (Fig. 7). Most of the rutile from rocks unaffected by the hydrothermal mineralizing system project along, or close to, the Ti-(Fe+Cr+V) axis (Clark and Williams-Jones, 2004), whereas the rutiles associated with metamorphic/metasedimentary processes tend to approach the Sn+W. These diagrams were used for both the rutile and the anatase analyzed in the present work. Even with a smaller volume of chemical data it is possible to verify, as shown in Grácio (2020) and Gaspar (2022), that the extension of the substitutions in the anatase, and therefore the incorporation of trace elements in its structure is smaller than in the rutile. The presence of grains with compositions that plot on the zones related with ore processes and on the zone related with metamorphic/metasedimentary processes shows the rutile grains of Type 2 have multiple sources, even within the same sample. In the case of the Ti oxides studied so far, it was not possible to establish a link between the populations identified and their chemical compositions, as is the case of cassiterites. However, it is noteworthy that in the most abnormal values of trace elements in anatase and rutile (Type 2) correspond to grains collected from samples located close to mineralizing bodies (i.e., 295-424, Ba-Pb Mineralized quartz veins; 295-85, Sn-W Mineralized quartz veins;295-445, Sn-W Mineralized quartz veins)

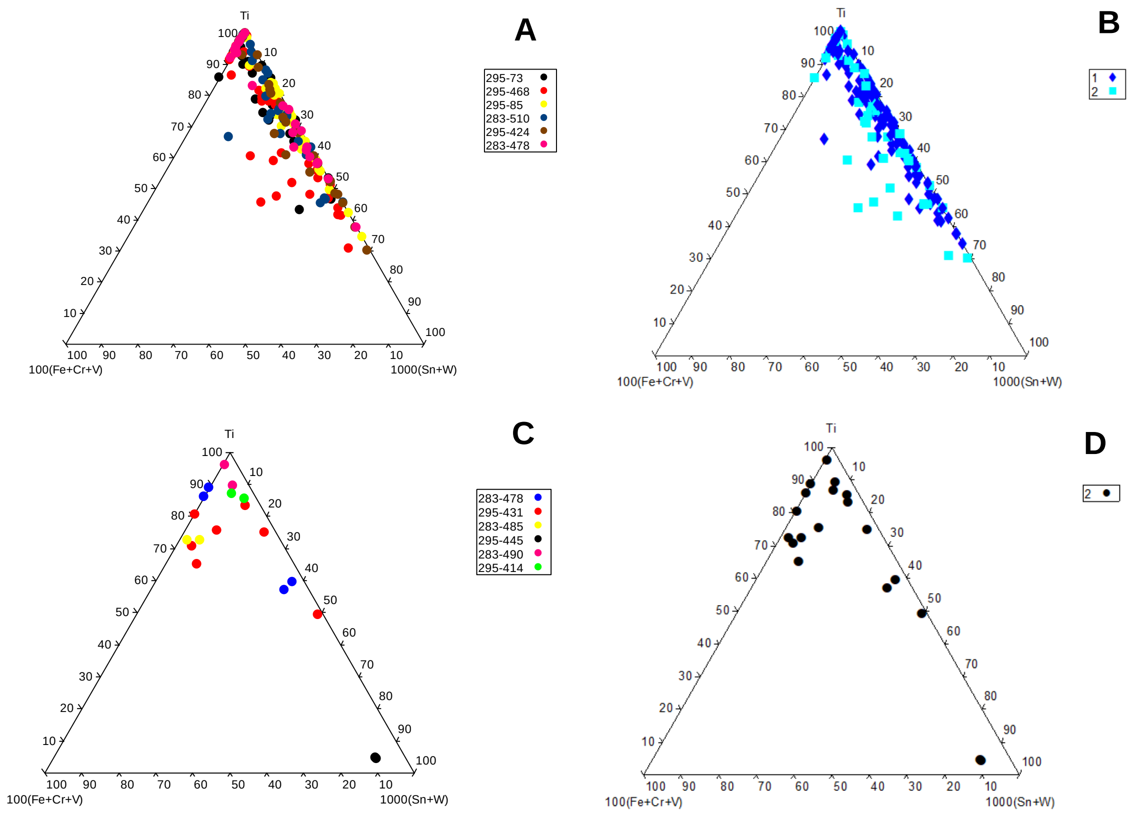
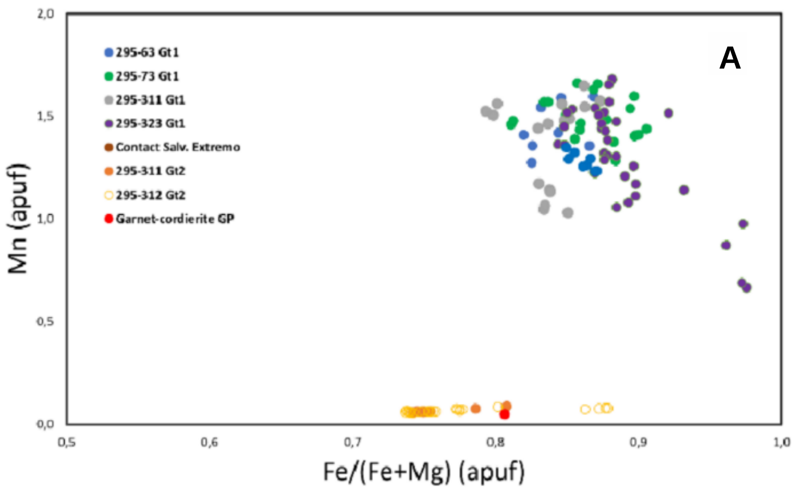


Fig. 7 – Discriminatory diagrams for alluvial anatase and rutile from Segura Mining Region (Polygon 1): A) Ti+Fe+Cr+V+Sn+W, for the anatase grains; B) Ti+Fe+Cr+V+Sn+W,for the anatase grains population (Type 1 and 2), C) Ti+Fe+Cr+V+Sn+W, for the rutile grains; D) Ti+Fe+Cr+V+Sn+W for the rutile grains population Type 2; adapted from Clark and Williams-Jones (2004)

As presented in the 2nd Annual report, the regional distribution, mineralogical and chemical preliminary data gathered for Type 1 and 2 garnet grains (Fig.8 A) show a positive correlation with the Mn-enriched spessartine observed in the contact metamorphic aureole contiguous to the Salvaterra do Extremo granite (to the north of Segura) and with the almandine found in Garnet-Cordierite Granite Porphyry dykes related to the Cabeza de Araya batholith (in Spain), the southeastern extension of the Segura granite.



B

	Garnet	
	Type 1	Type 2
SnO2	0,00	0,00
TiO2	0,43	0,01
SiO2	36,18	37,20
Fe2O3	0,00	0,28
Cr2O3	0,08	0,07
Al2O3	20,07	21,05
FeO	14,37	32,04
MnO	22,69	0,95
CaO	2,81	1,02
MgO	1,45	5,99
H2O	0,00	0,25
F	0,00	0,00
Total#	98,07	98,87
O=F	0,00	0,00
Total	98,07	98,87

Fig. 8 – A) Mn vs Fe/(Fe+Mg) diagram for alluvial garnet populations (Gt1: Type 1, spessartine; Gt2: type 2, almandine) from Segura. Spessartine data from contact metamorphism halo metasedimentary rocks in adjacent Salvaterra do Extremo region (to N of Segura) and almandine data from Garnet-Cordierite Granite Porphyry dyke associated with Cabeza de Araya batholith (Spanish territory; Corretgé and Suárez, 1994), were also plotted, showing positive correlation with alluvial garnet Type 1 and 2 from Segura, respectively (from MOSTMEG 2nd annual Progress Report). B) EPMA analysis of a garnet type 1 (295-63) and type 2 (295-311).

4. Scientific collaboration

During the time under consideration, the grant holder has participated in several meetings with the MOSTMEG partners (transnational project), mainly in the context of the organization and development of Task 4.3 activities, including working in FCUL facilities, but also in the 2nd Annual meeting MOSTMEG (Transactional Project; September 4, 2022) with other national and international MOSTMEG Transnational project partners. Moreover, he has contributed to the production of the 2nd Annual Progress report (2022) and its work will be a contribute to the 3rd Annual Progress Report (2023), as well as, to Deliverable D. 4.3 (to be delivered at the end of the Task 4.3). Regarding scientific publications, he has participated as coauthor in one scientific paper (with LNEG, FCUL and Hércules members partners) and one abstract (with LNEG and FCUL members partner):

Gaspar, M. **Grácio, N**. Salgueiro, R. Costa, M., 2022. Trace Element Geochemistry of Alluvial TiO_2 Polymorphs as a Proxy for Sn and W Deposits. Minerals, 12, 1248. https://doi.org/10.3390/min12091067 (see attached).

Salgueiro, R., **Grácio, N.**, Gaspar, M., de Oliveira, D., 2023 (accepted). Alluvial Sn and W minerals mapping for mineral resources exploration and research in Segura mining region (Portugal). Resumos do XI CNG, Coimbra July 17-19.

5. Final considerations

The work proposed in the workplan, regarding the mineralogical study of HM, handpicking and production of mounts, is in its final phase and is expected to be completed by the end of the Research Grant (May 20). At least part of the chemical analyses (dependent on the partners) and the associated data processing and interpretation are still lacking, which is why the request for an extension of the Research Grant was made. It is safeguarded that, eventually, with the progress and development of the work, especially the chemical analyses and respective data processing, the need may emerge for new mineralogical studies and/or new data processing in this scope, handpicking of minerals and production of mounts for further analysis.

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Alfragide, April 20, 2023,

Nuno Grácio

Nuno Miguel S. C. Grácio