The usefulness of alluvial heavy minerals in the exploration of granite-related mineral systems; the case of Segura

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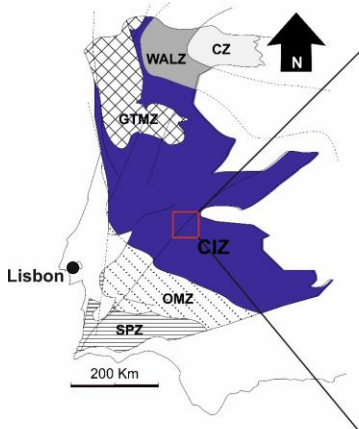
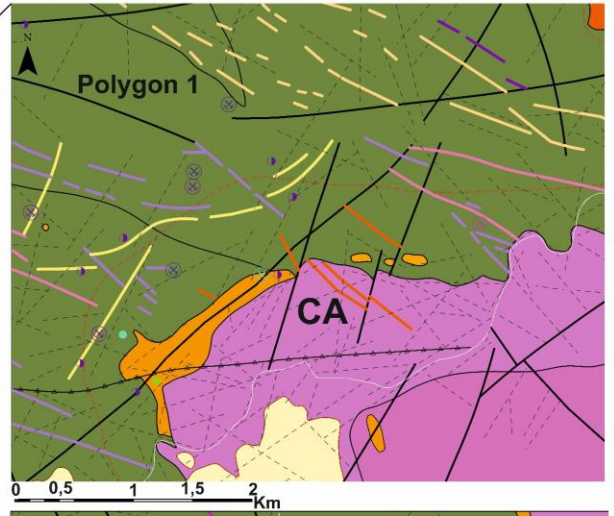
The usefulness of alluvial heavy minerals in the exploration of granite related mineral systems; the case of Segura

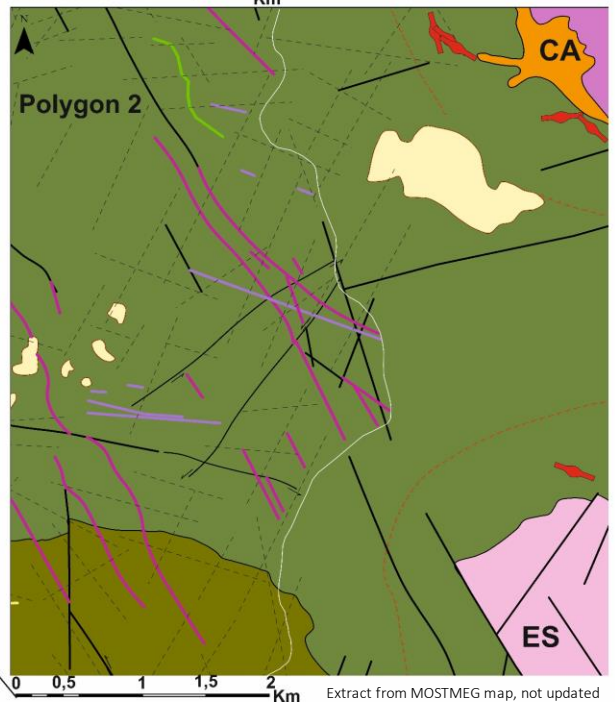
Segura Mining Region (Polygon 1) and Southern Segura Region (Polygon 2)

Central-Iberian Zone

Góis-Segura Sn-W metallogenetic belt







Extract from MOSTMEG map, not updated

Faults and dykes

- Fault
- Inverse fault
- Fault, certain
- Fault, Certain, Left
- Quartz dyke
- Mineralized quartz breccia dyke (Ba/Pb)
- Lamprophyre
- Tonalitic porphyre
- Aplite/pegmatite dyke
- Granodioritic porphyre dyke
- Felsic and intermediate dyke
- Mafic and intermediate dyke

Inactive Mines and occurrences

- Ba+Pb in Qz load
- Ba+Pb mine, inactive
- Pb mine, inactive
- Qz load with cassiterite (Sn)
- Sn mine, inactive
- Sn/W mine, inactive
- Li mine, inactive
- U ores in granite
- Sn-W veins

Lithology

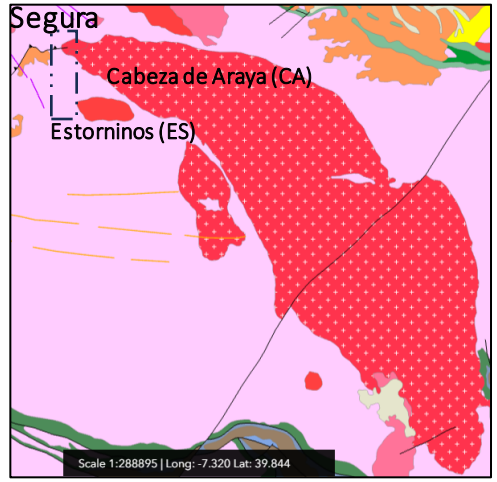
- Pegmatite
- Fine grained muscovite granite
- Tonalite
- Cordierite-biotite granites
- Porphiroid granite
- Porphyroid biotite granites
- Cenozoic
- Greywackes
- Slates and greywackes, MTF; Upper Member
- Slates and greywackes, MTF; Lower Member

Metamorphic boundary

- Contact metamorphism aureole (silimanite+cordierite isograd)

✓ Complex Geological setting: Superimposition of Geological / Metallogenetic / Tectonic Events

✓ Complex Mix of Sources in the Alluvial Deposits



Extract from Geologic map of Iberian Peninsula, scale 1M:
https://geoportal.lneg.pt/mapa/#

Representativeness and Mineral Assemblage of Outcropping Lithotypes

Complex Mix of Heavy Minerals Sources in the Alluvial Deposits

- ✓ Granites
- ✓ SGC metasedimentary rocks
- ✓ Contact metamorphic halo rocks
- ✓ Ba-Pb-Zn intra and peri batholitic veins; in tectonic structures (up to 3 m x 2500 m)
- ✓ Mineralized quartz-breccia veins
- ✓ Several barren veins and dikes

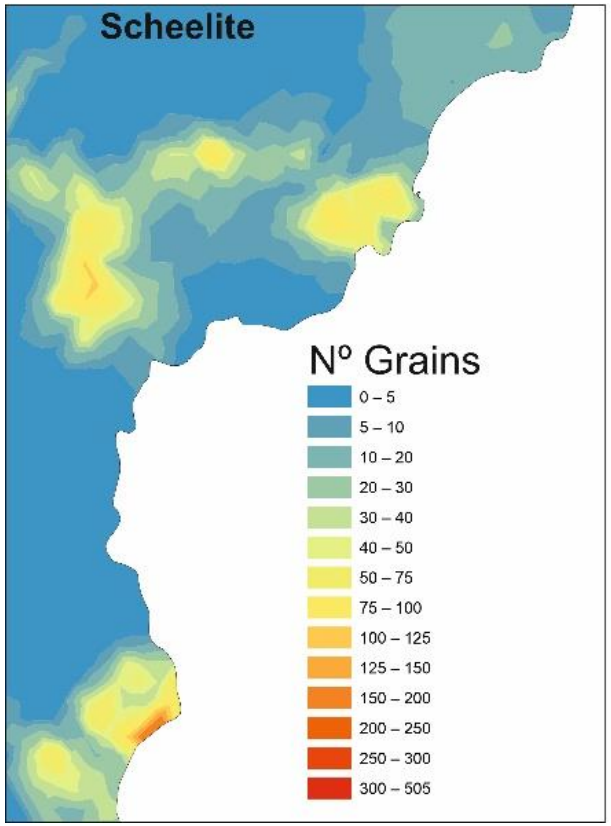
- ✓ Sn-W hydrothermal peri batholitic veins (up to 10-50 cm x 1300 m; filing tensile cracks)
  - Tourmalinization, silicification ± arsenopyritization (cm-dm) in host rocks;
- ✓ Sn-bearing aplites/quartz lodes
- ✓ Li (-Sn) aplito-pegmatites (up to < 15 cm x 300 m)

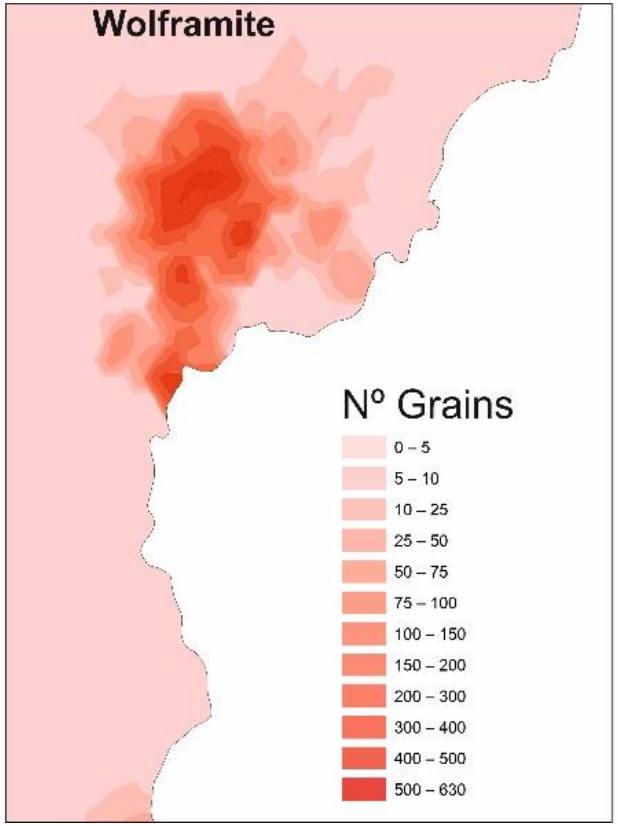
Alluvial Heavy Minerals Selected to Study

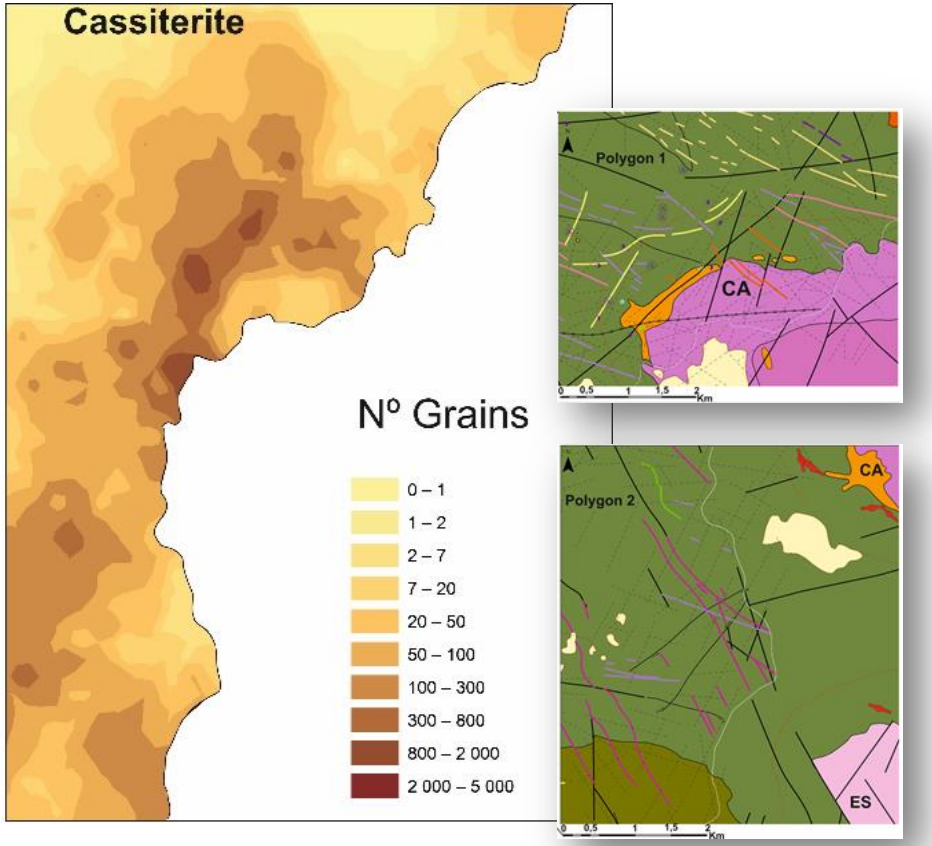
✓ *Mineral fingerprints & footprints _ Sn and W Mineralisations*

- **Cassiterite**, **Wolframite** and **Scheelite**: Sn-W ore minerals; indicators of Sn - W ore deposits;
- **Rutile** (**Anatase** and **Brookite**): proxies to Sn –W mineralisations;
- Additionally: **Tourmaline, Garnet** and other **Heavy Minerals**.

Scheelite, Wolframite and Cassiterite Grains Abundance Maps

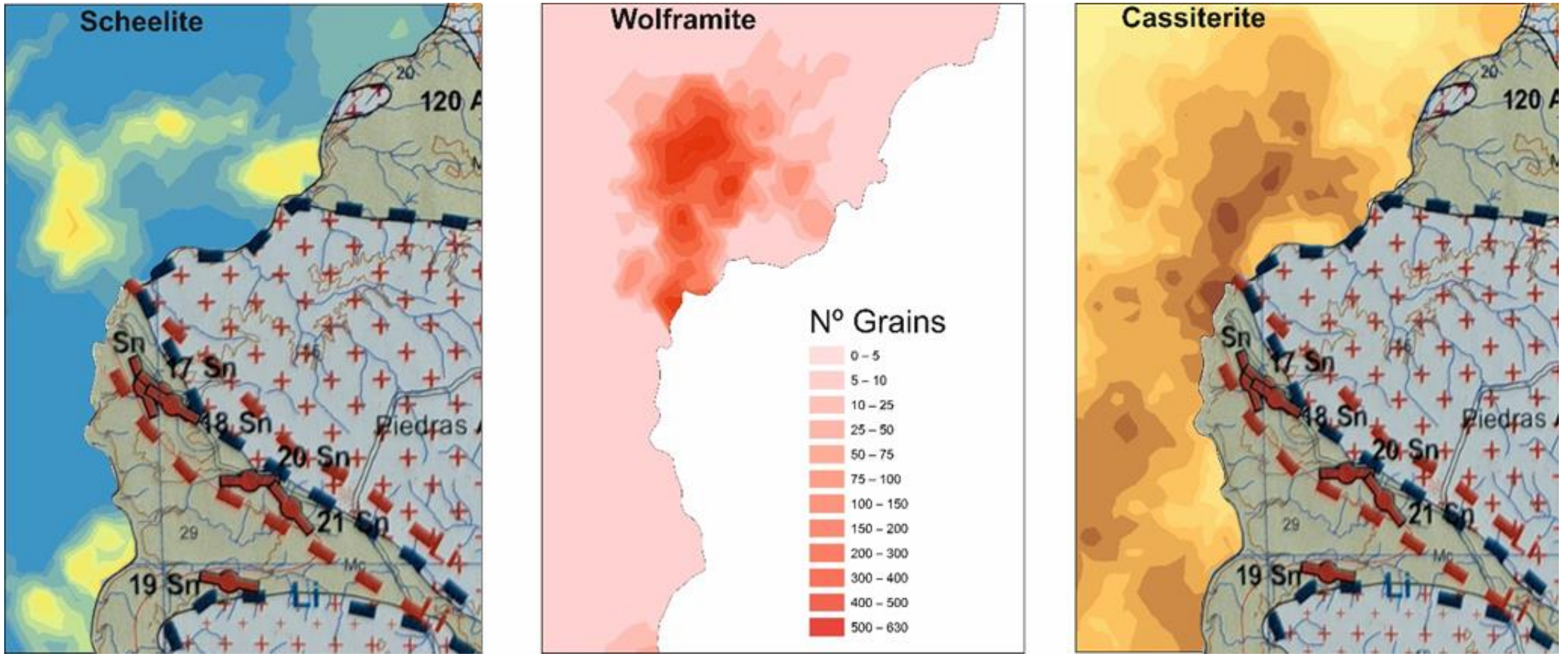






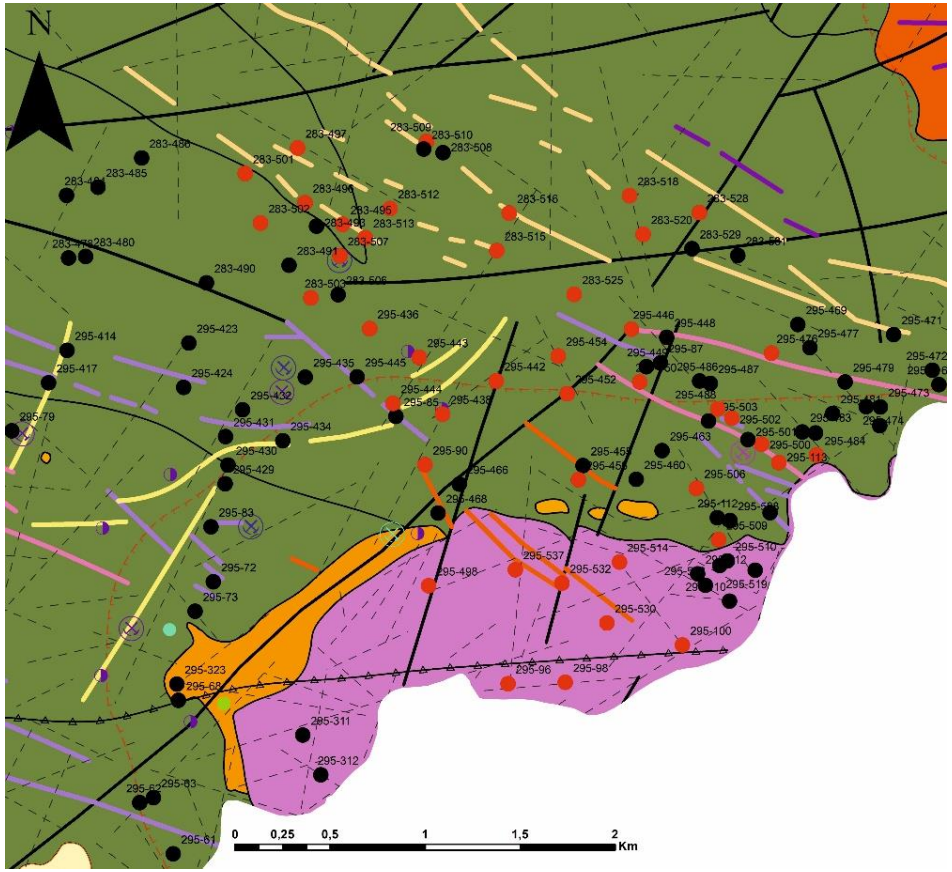
Maps of the abundance by the total number of grains of : scheelite, wolframite and cassiterite; 647 samples data from LNEG old surveys in which *are included the samples from Polygon 1 and 2 (reassessed under the MOSTMEG project)*

Ore Mineral Grains Abundance Maps

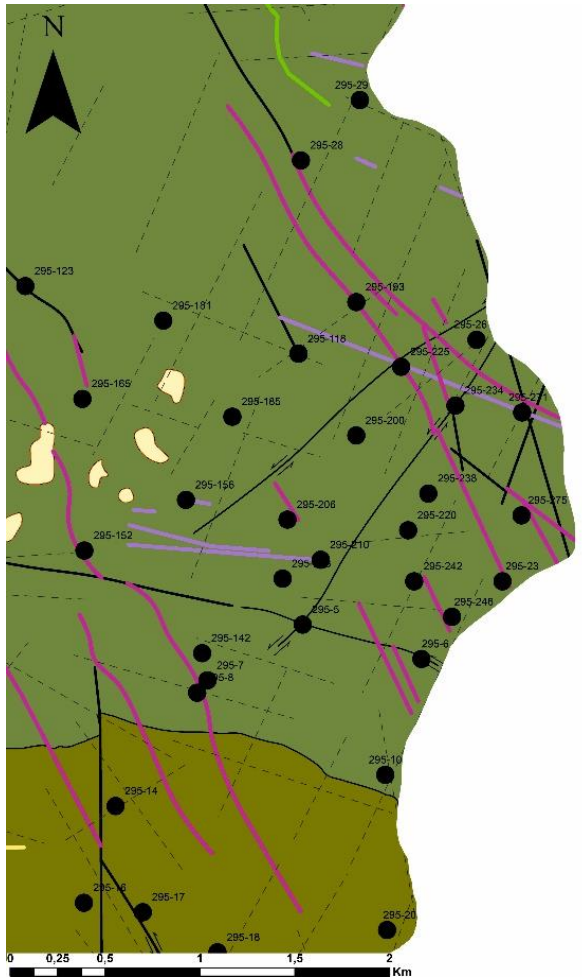


Maps of the abundance by the total number of grains of: scheelite, wolframite and cassiterite; 647 samples data from LNEG old surveys in which *are included the samples from Polygon 1 and 2. reassessed under the MOSTMEG project; attempt to adjust with an e*xtract of Mapa metalogenético de Extremadura, scale: 1:250000 (IGME, 2007).

The Alluvial Samples Selection

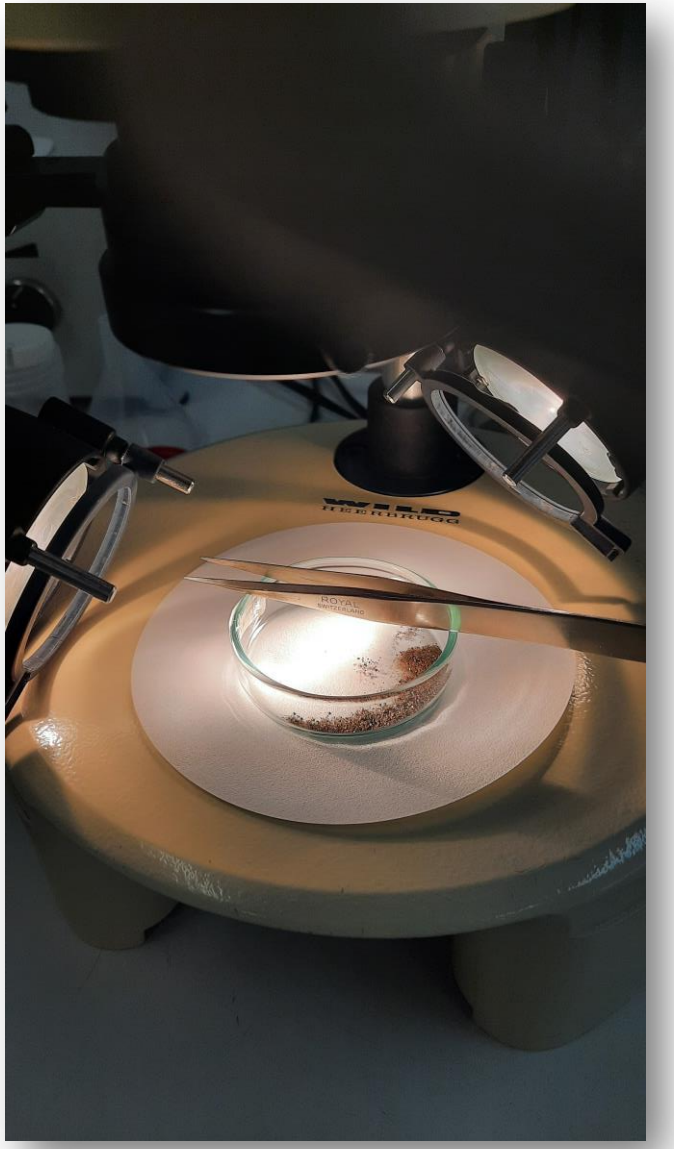


*Location of the 69 alluvial samples from the **Polygon 1** studied in MOSTMEG: black dots; Location of the additional 43 alluvial samples studied by Grácio (2020): red dots.*



*Location of the 35 alluvial samples from the **Polygon 2** studied in MOSTMEG.*

Identification _ Semi-quantification _ Characterisation of Heavy Minerals



- ✓ **Under binocular microscope**

- Alluvial Heavy Mineral Regional Assemblage:
  cassiterite, wolframite, scheelite, gold, cinnabar, sulphides, barite, galena. rutile, anatase, brookite, tourmaline, garnet, zircon, andalusite, ilmenite, iron ox., topaz, biotite, muscovite, apatite and sulphides among others.

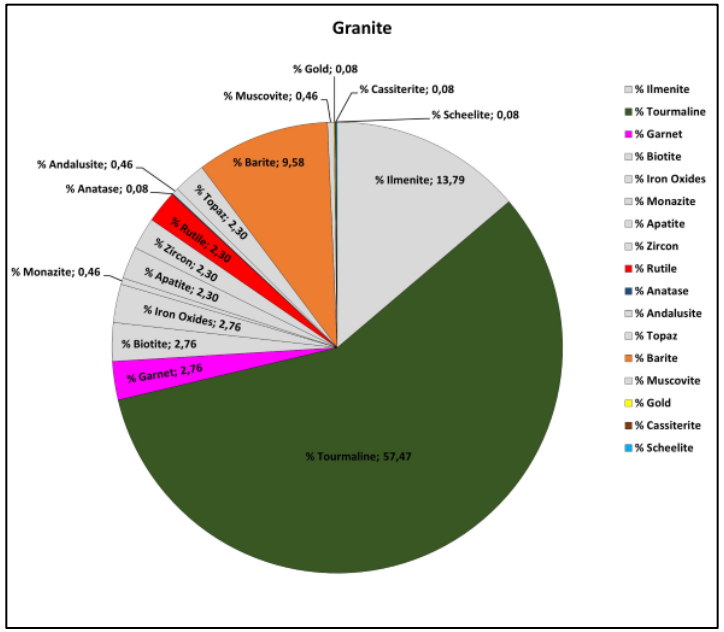
- Mineral grain populations based on physycal properties: colour, habit, luster, zonation, diaphaneity, mineral inclusions…

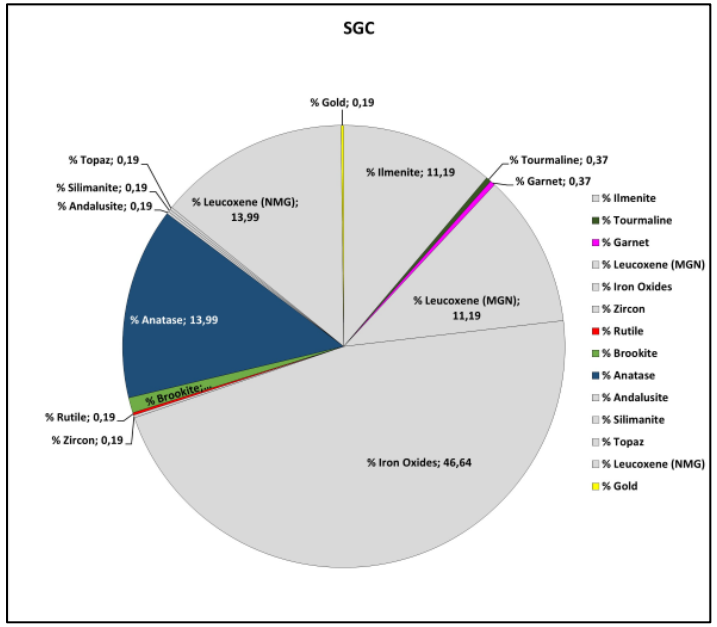
- Relative mineral and mineral populations abundance:

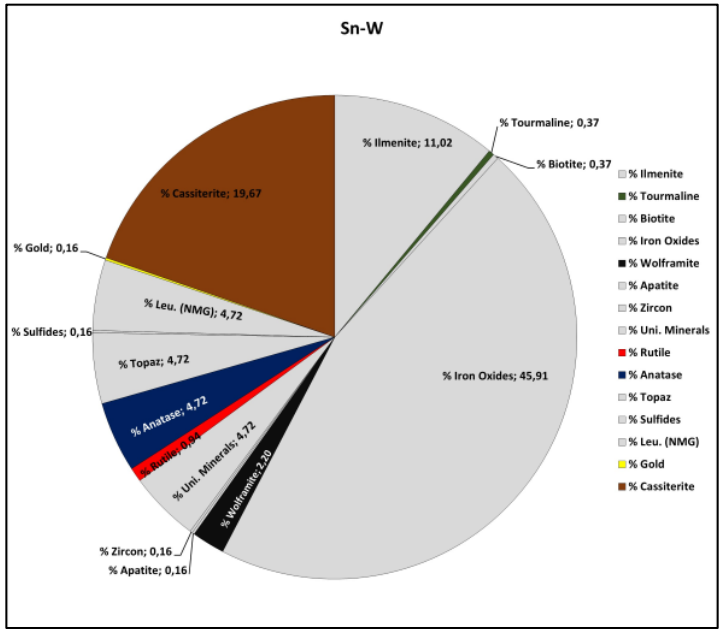
V: (0,01- 1 %); R: (1 - 5 %); P: (5 – 25 %); Md: (25 – 50 %); A: (50 - 75 %); M: (75 - 100 %); (adapted from Parfenoff et al., 1970).

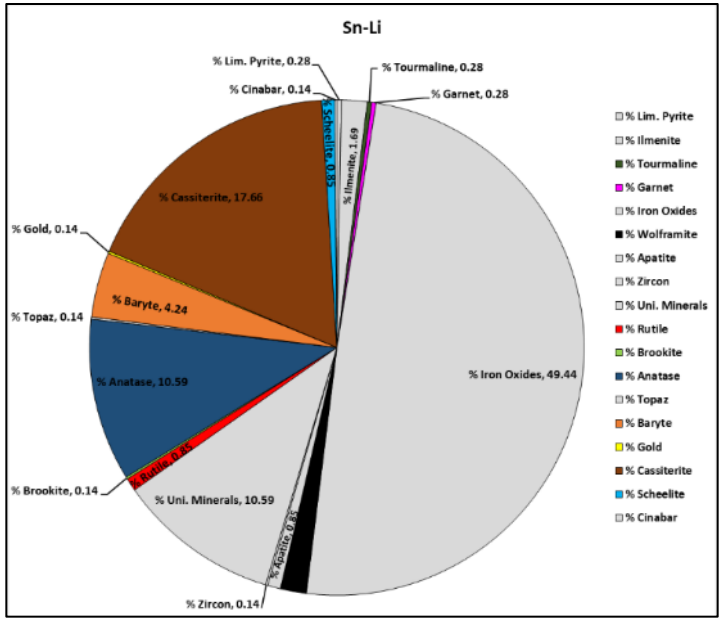
Calculations carried out with **Average (%)** values;

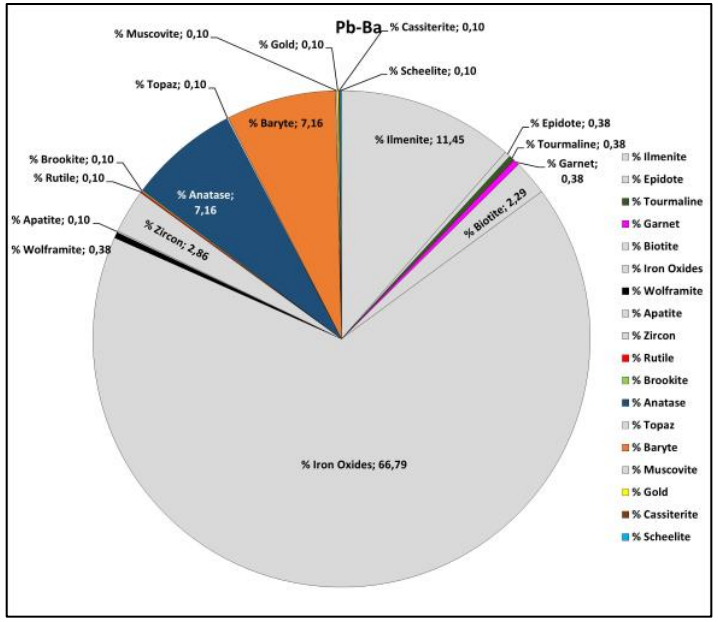
Polygon 1_ Distinct Sources

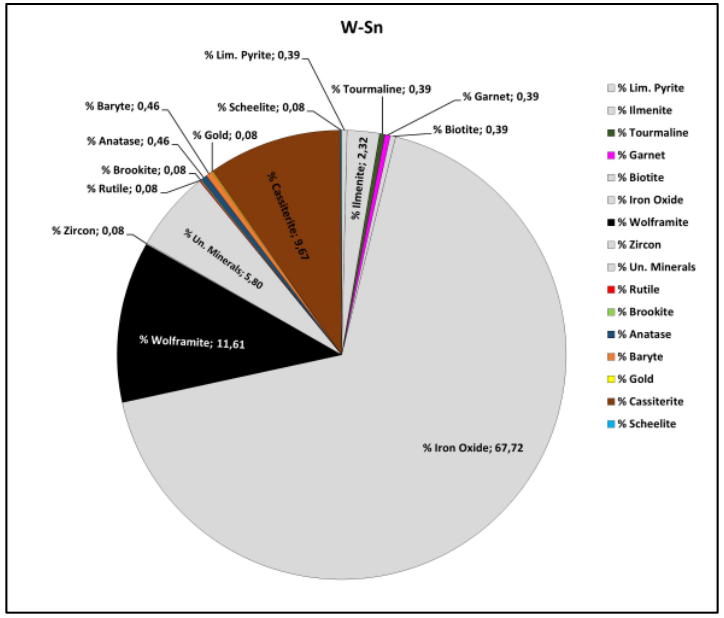








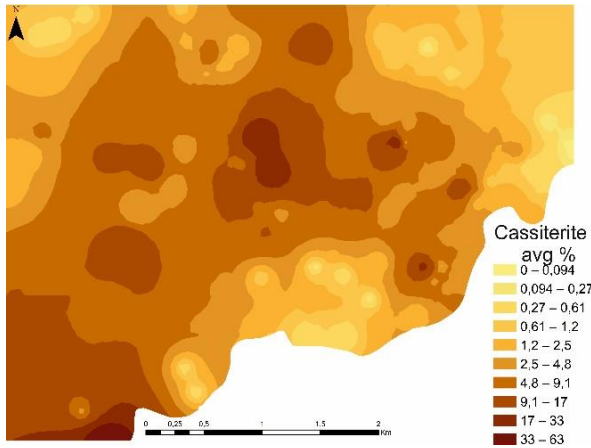


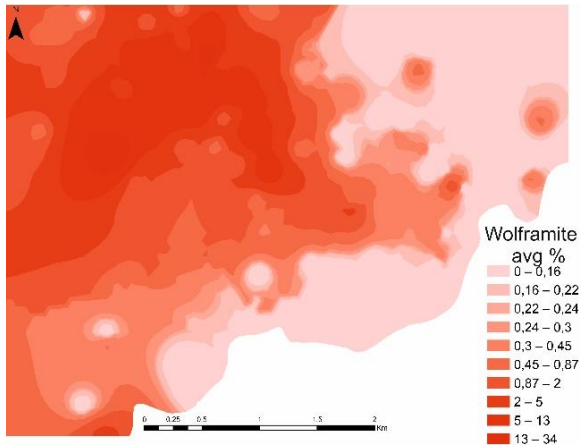


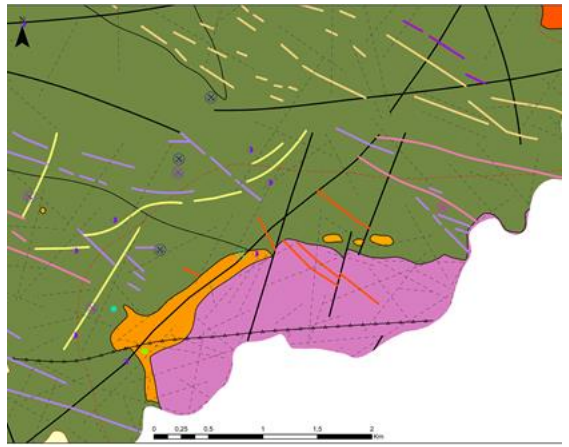
Pie charts of six samples chosen as examples of alluvial heavy minerals (Polygon 1) collected in areas under the influence_of specific lithologies to alluviums: Segura Granites; SGC Metasediments; Sn-W Mineralised quartz veins; Sn-Li Mineralised aplite-pegmatite veins;; Ba-Pb-Zn mineralised quartz veins; W-Sn Mineralized quartz veins

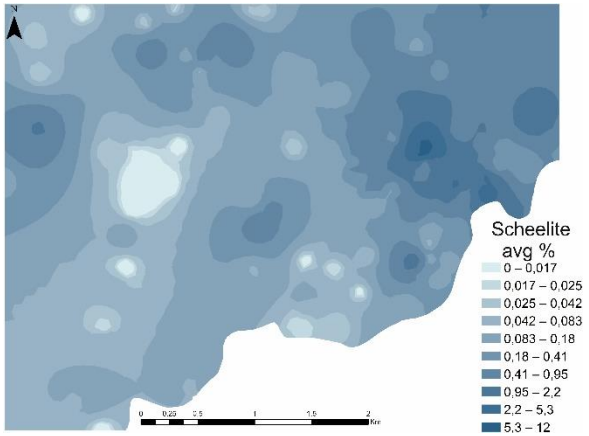
Segura Mining region (Polygon 1)_ Mineral Average Abundance Maps

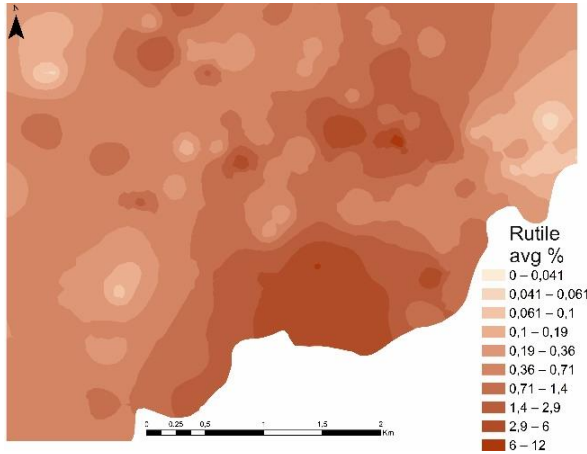
MOSTMEG Project and Gracio (2020)_(total: 112 samples)

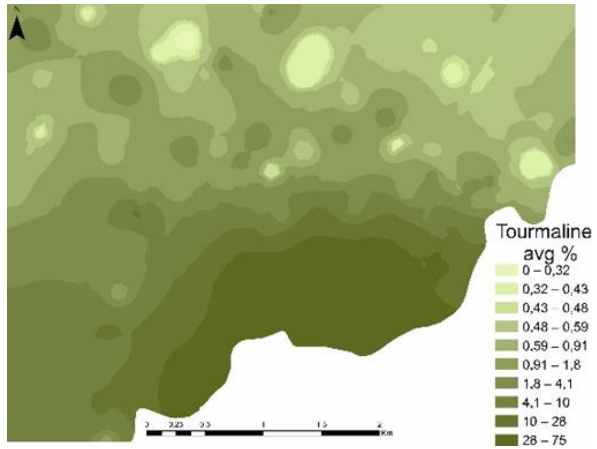


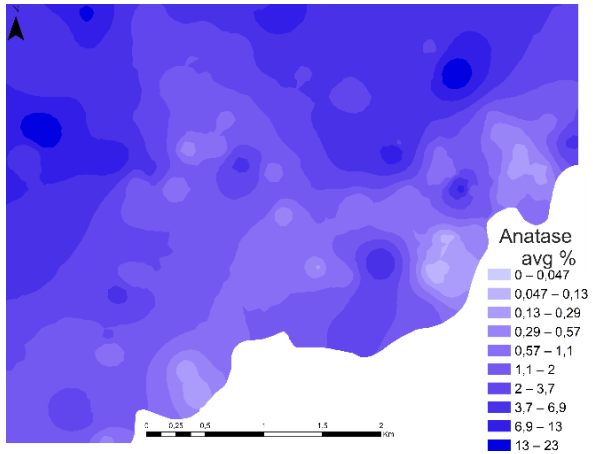


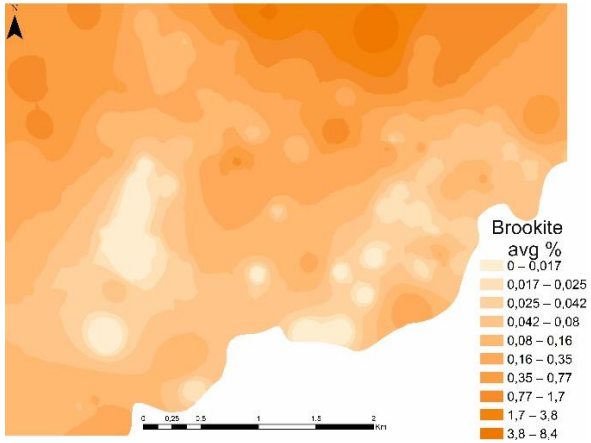


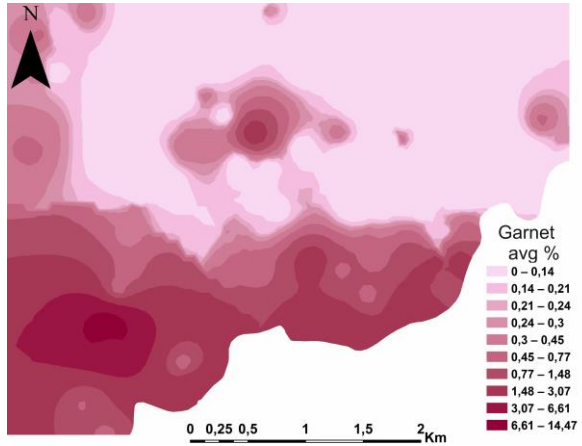






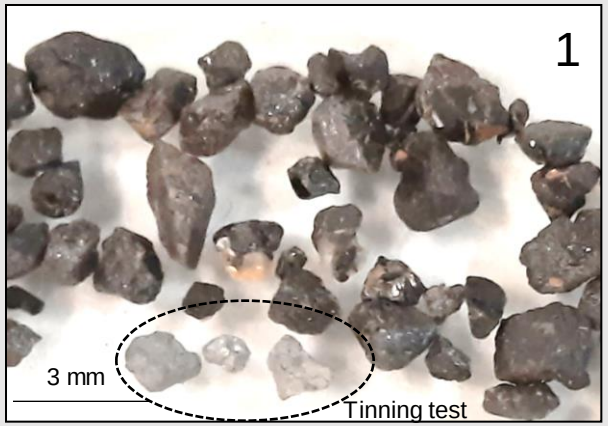


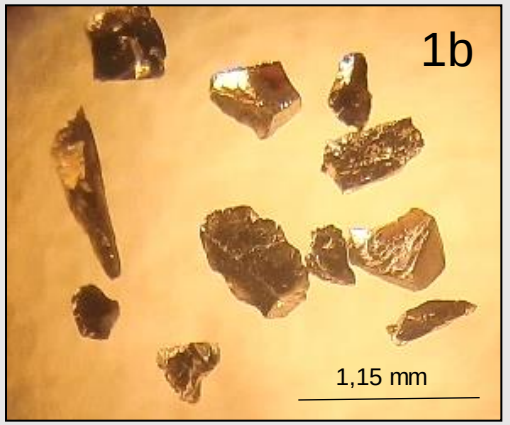


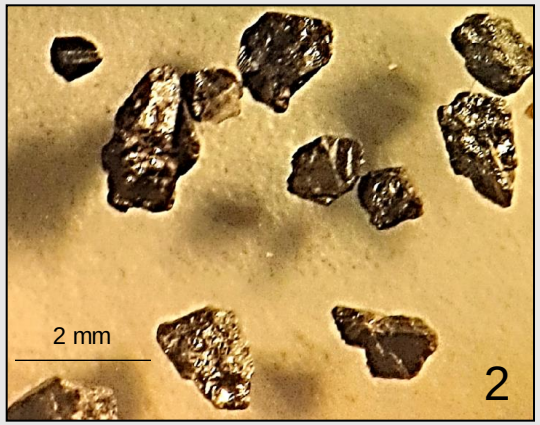


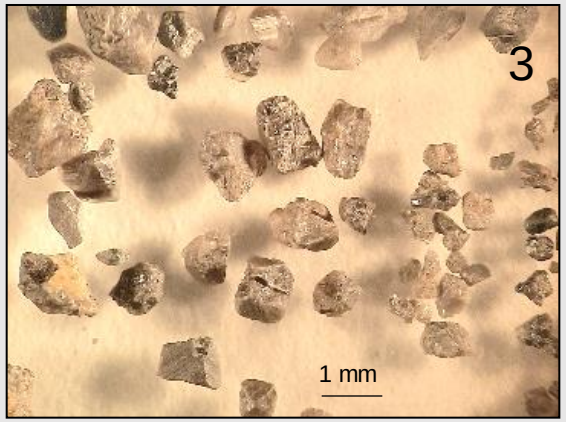
Cassiterite grain populations

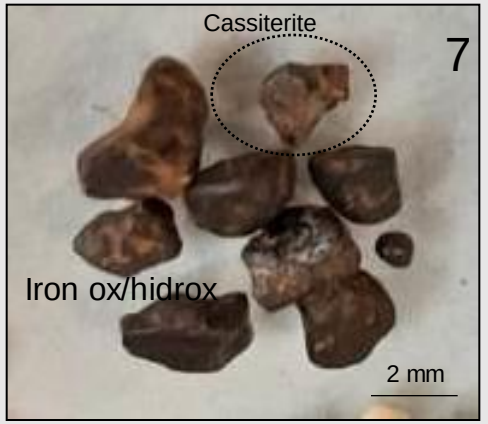
- 7 (+2) populations based mainly on their color





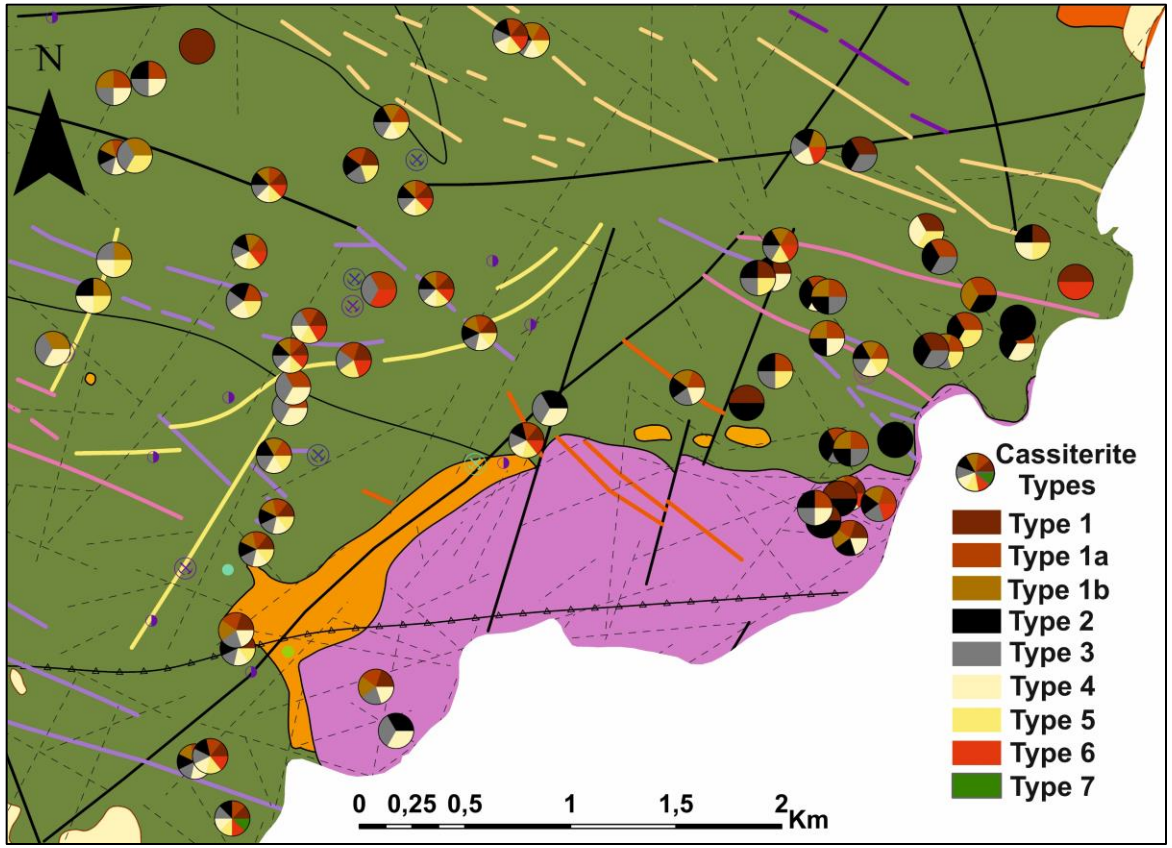


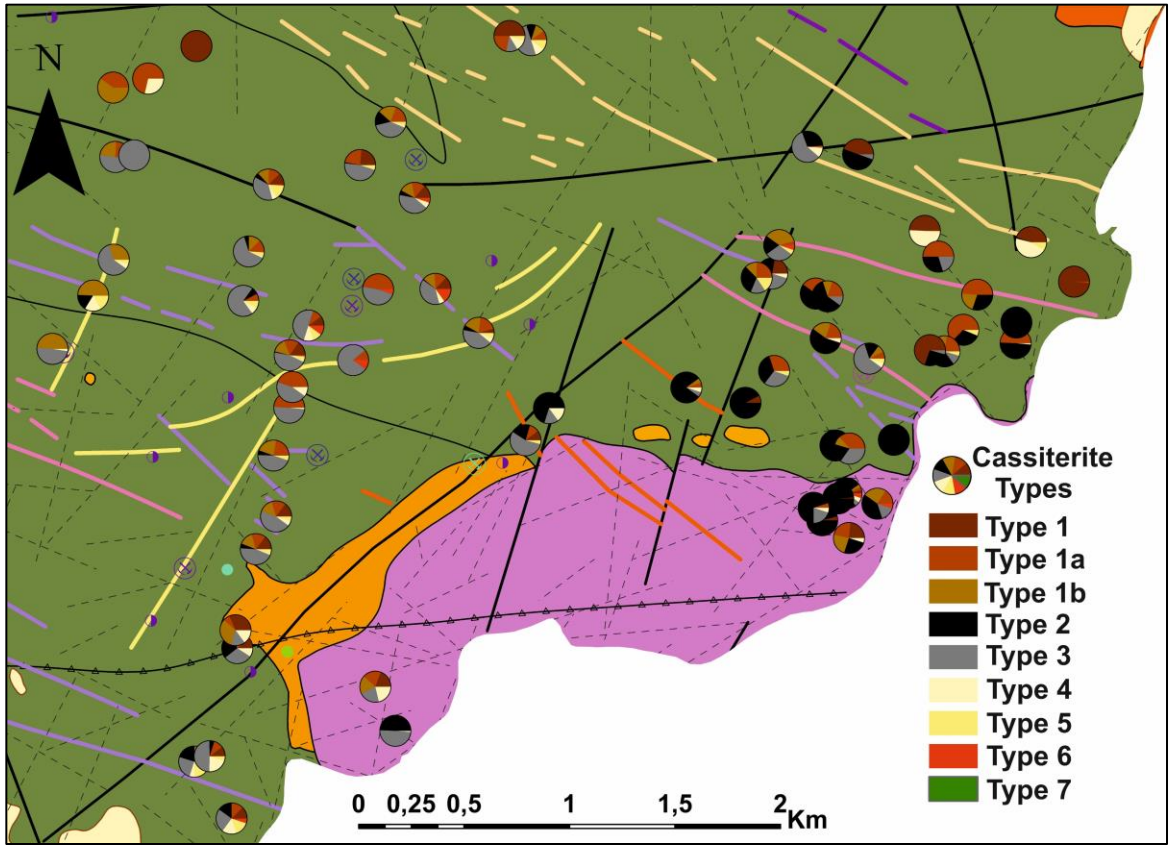




Cassiterite Grain Populations

✓ 7 (+2) populations based mainly on their color



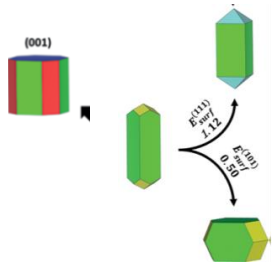


Rutile Grain Populations

- 4 Groups based on their habit (7 populations)

Fine to coarse

Rt_A
Prismatic
(black, red)

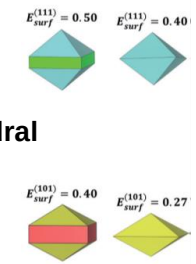


Rt_B
Anhedral
(black, red and brownish red)

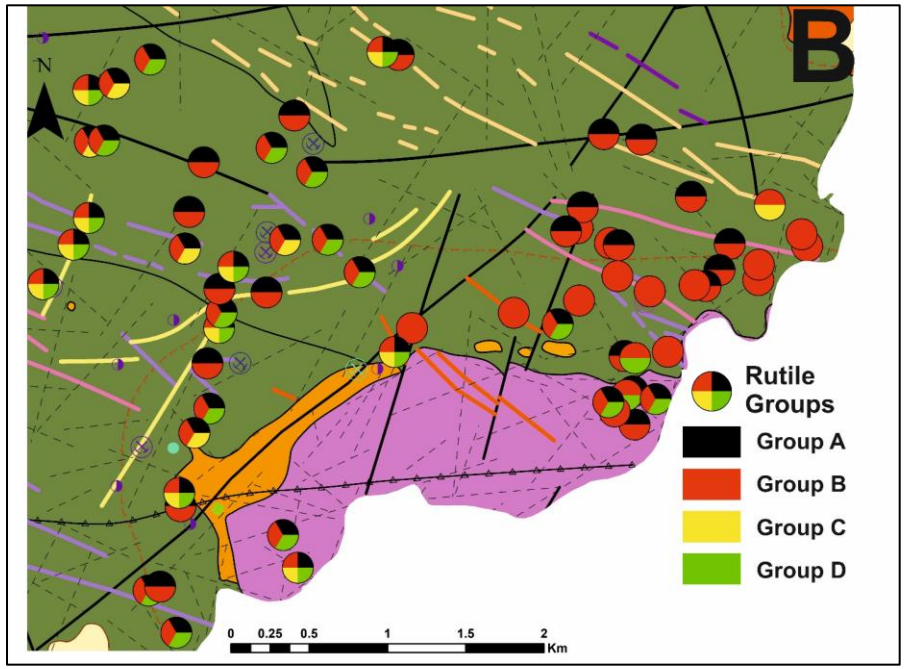
Fine to medium

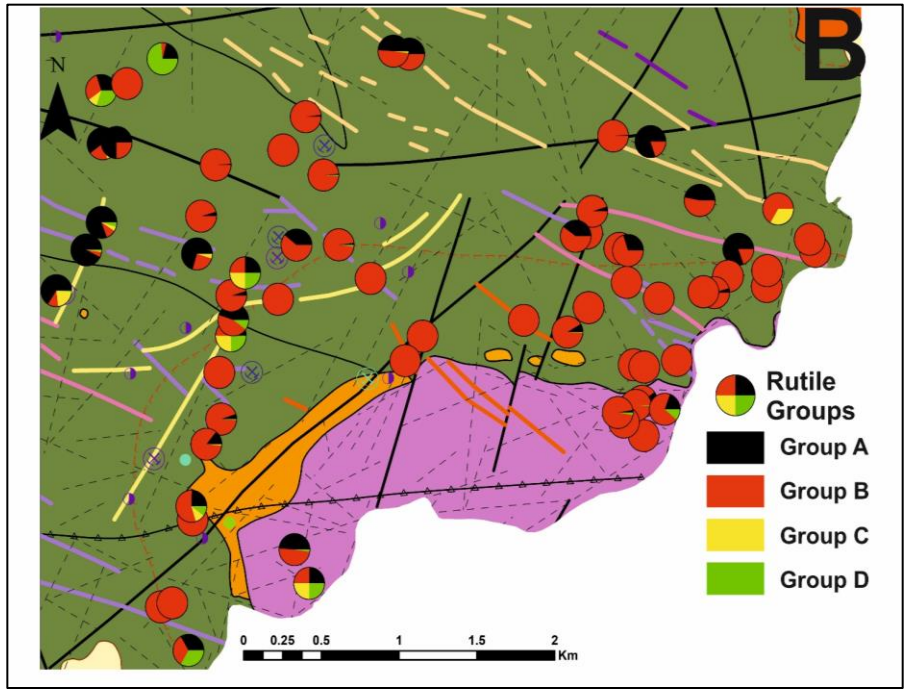
Rt_C
Anhedral or acicular
polycrystalline aggregates
(honey, reddish brown)

Rt_D
Bipyramidal and others euhedral
undifferentiated
(black brownish red, red;



Rutile habit draws adapted from Barbosa et al. (2017)

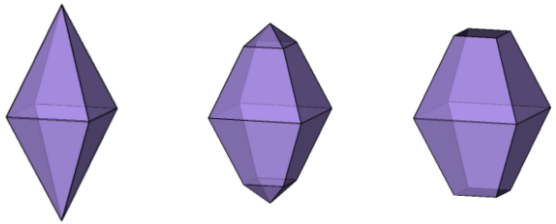




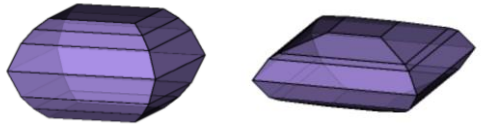
Anatase Grain Populations

✓ 2 populations based on their habit:

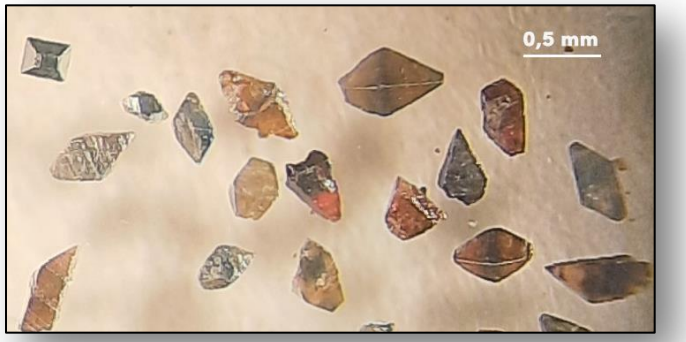
Type 1: Bipyramidal

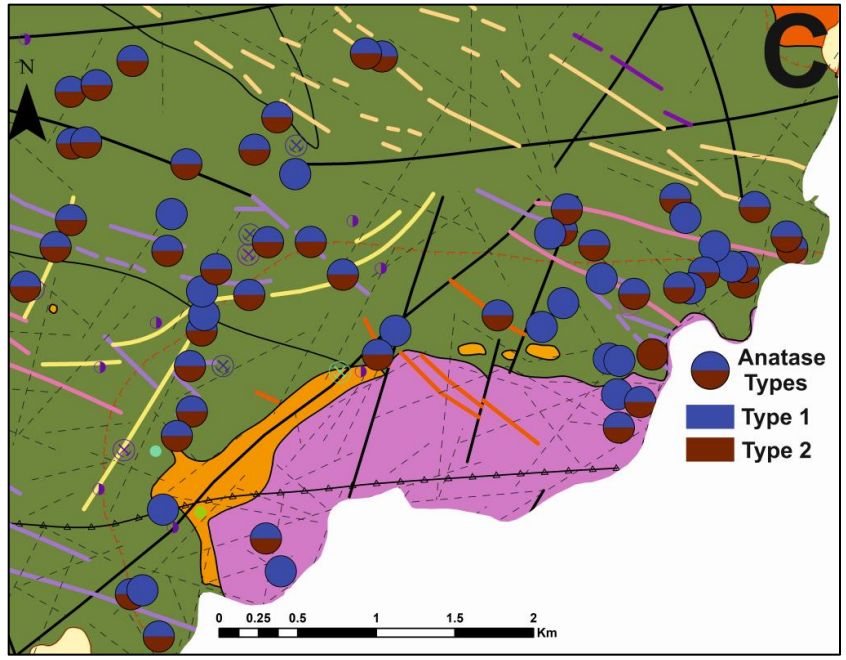


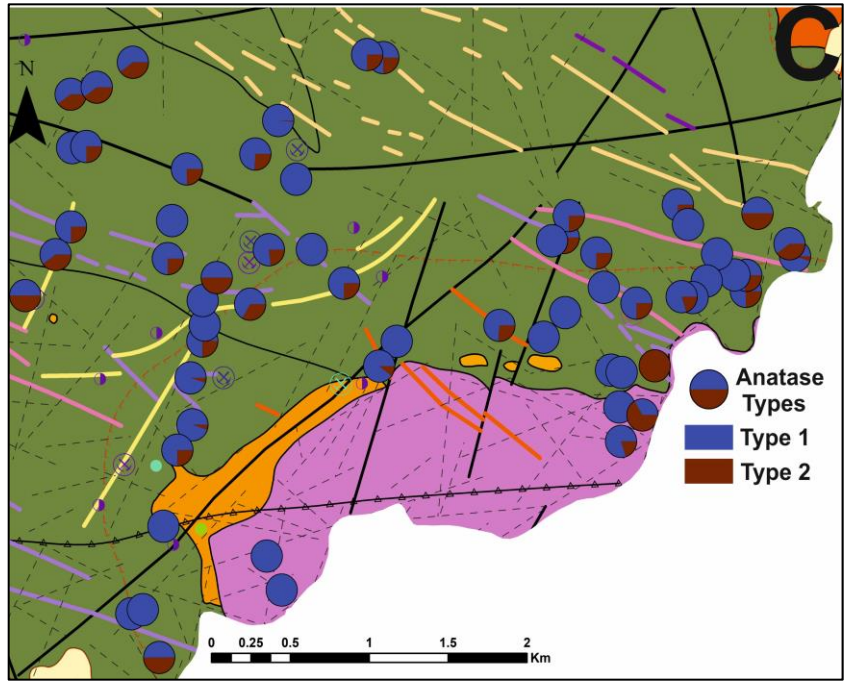
Type 2: Basal



- Great color variation, but shades of blue and brown are dominant





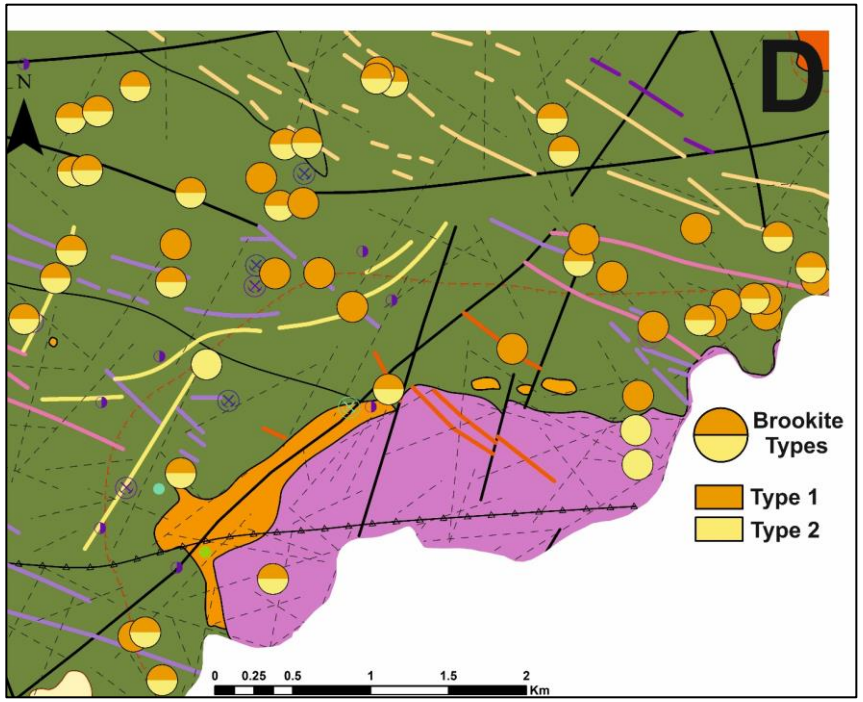


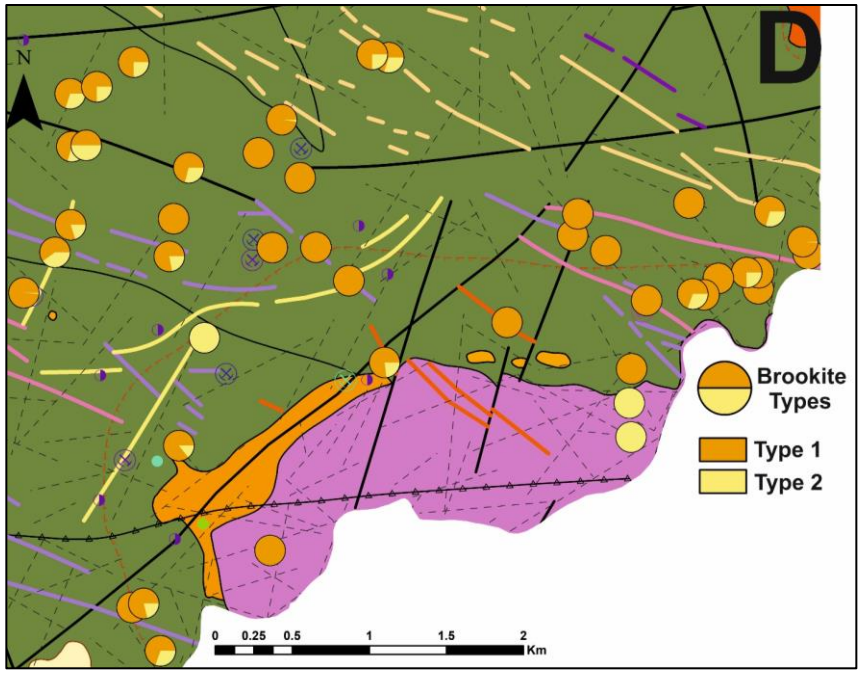
Brookite Grain Populations

- ✓ 2 populations based on their color

Brookite_1 (orange, brownish orange)

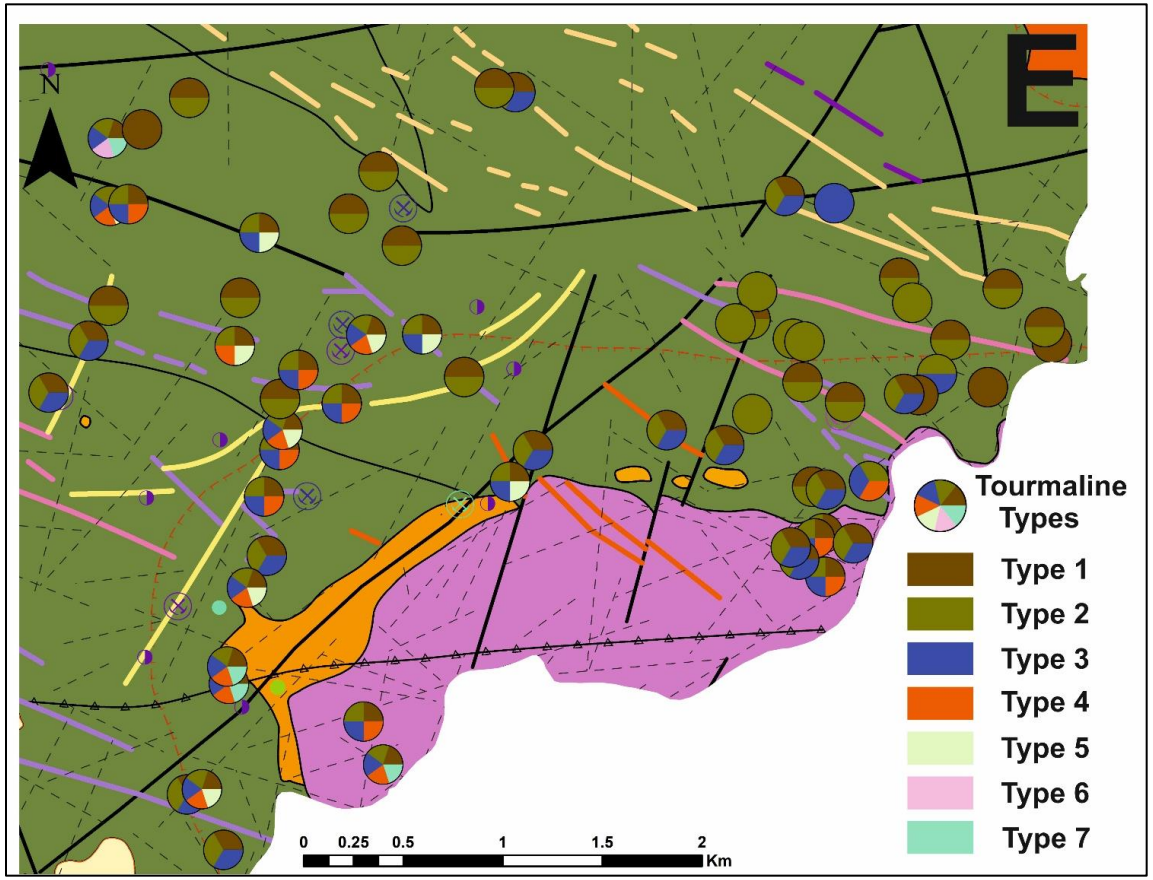
Brookite_2 (orange, greenish yellow)

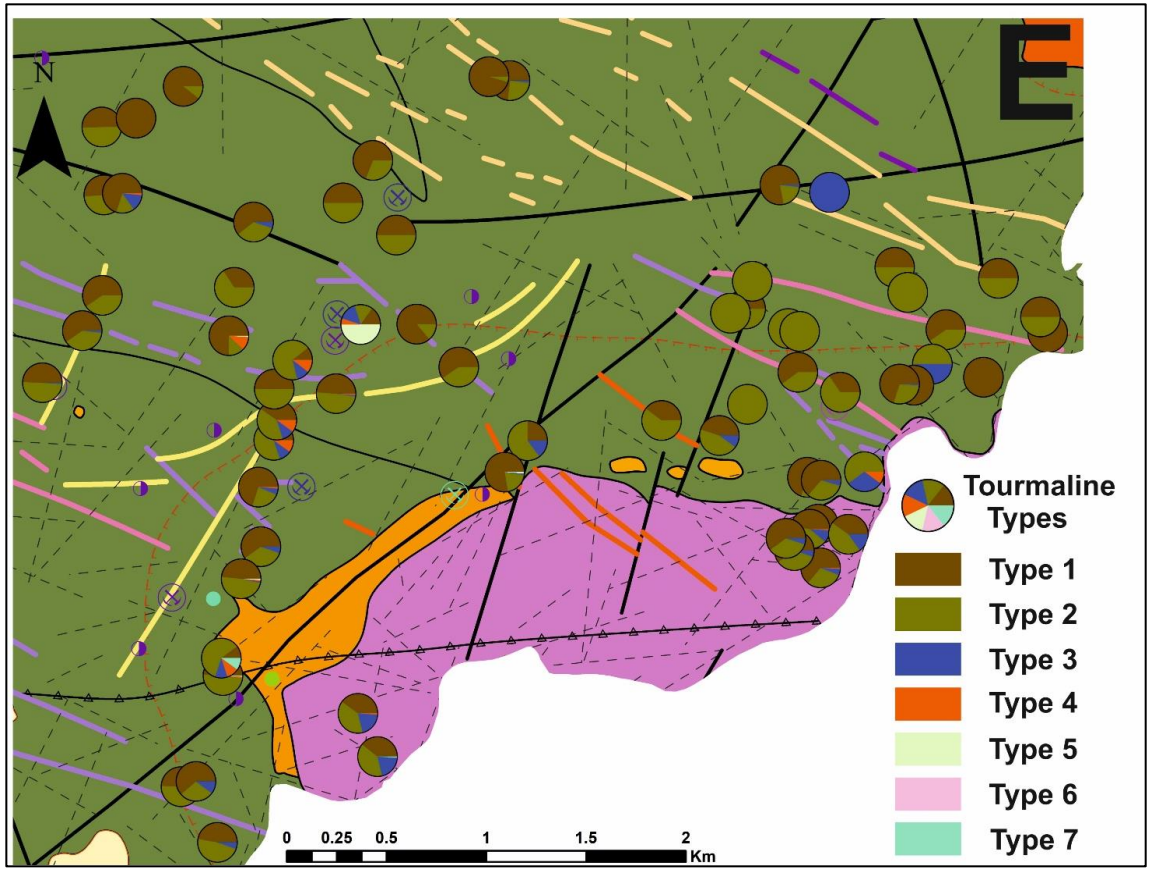




Tourmaline Grain Populations

✓ 7 populations mainly based on their color



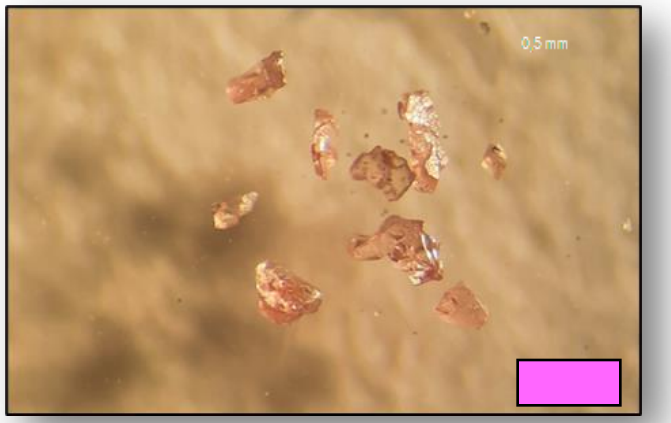


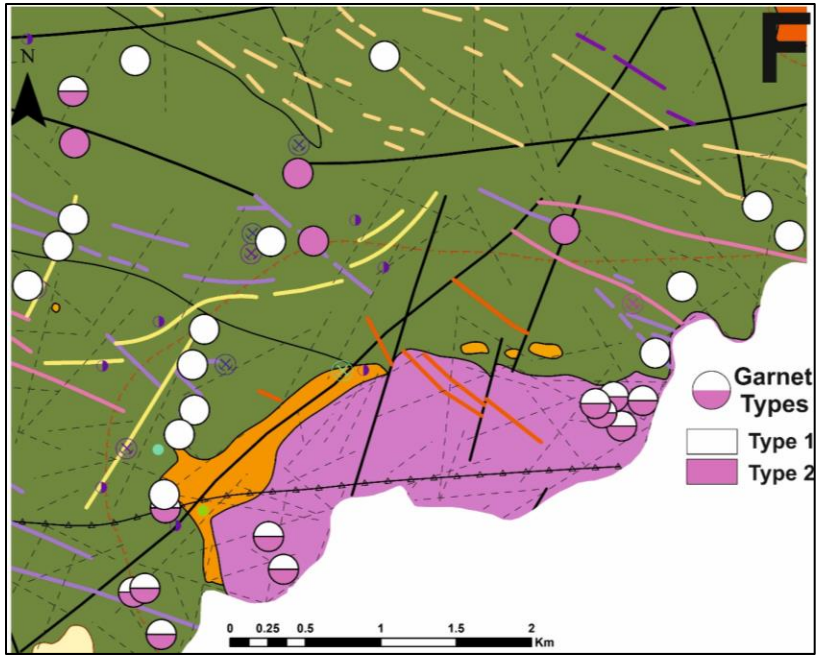
Garnet Grain Populations

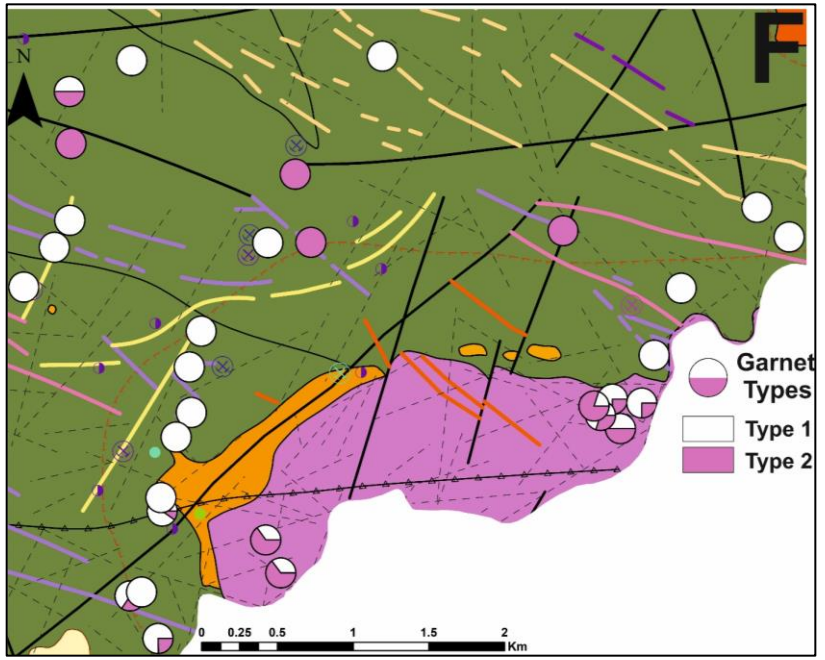
✓ 2 garnet populations

- **Type 1**: Euhedral, Spessartine-almandine with mineral inclusions: ilmenite (Mn), monazite, zircon; quartz....;

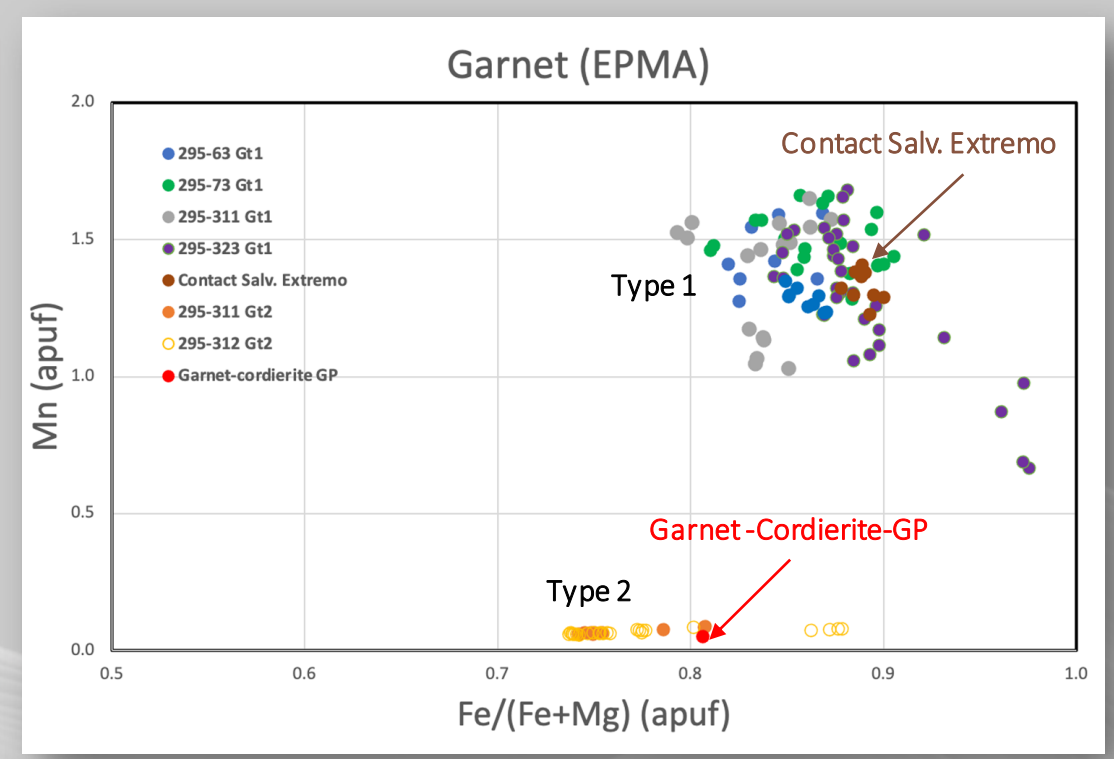
- **Type 2**: Anhedral, Almandine-pyrope;

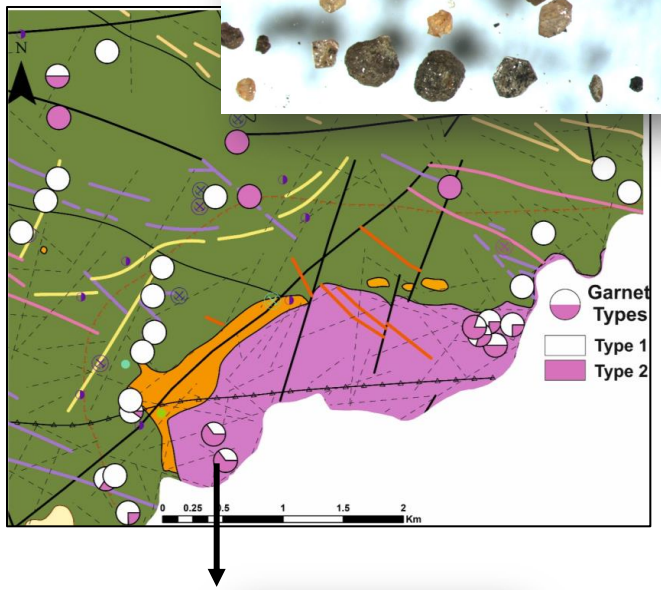


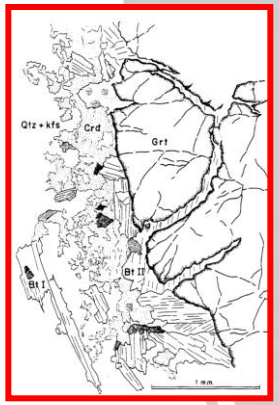


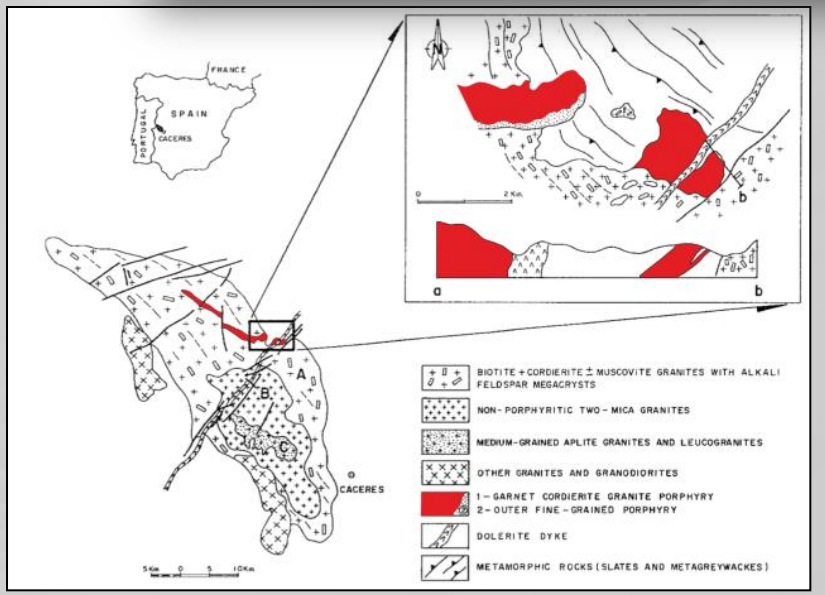


Garnet Grain Populations



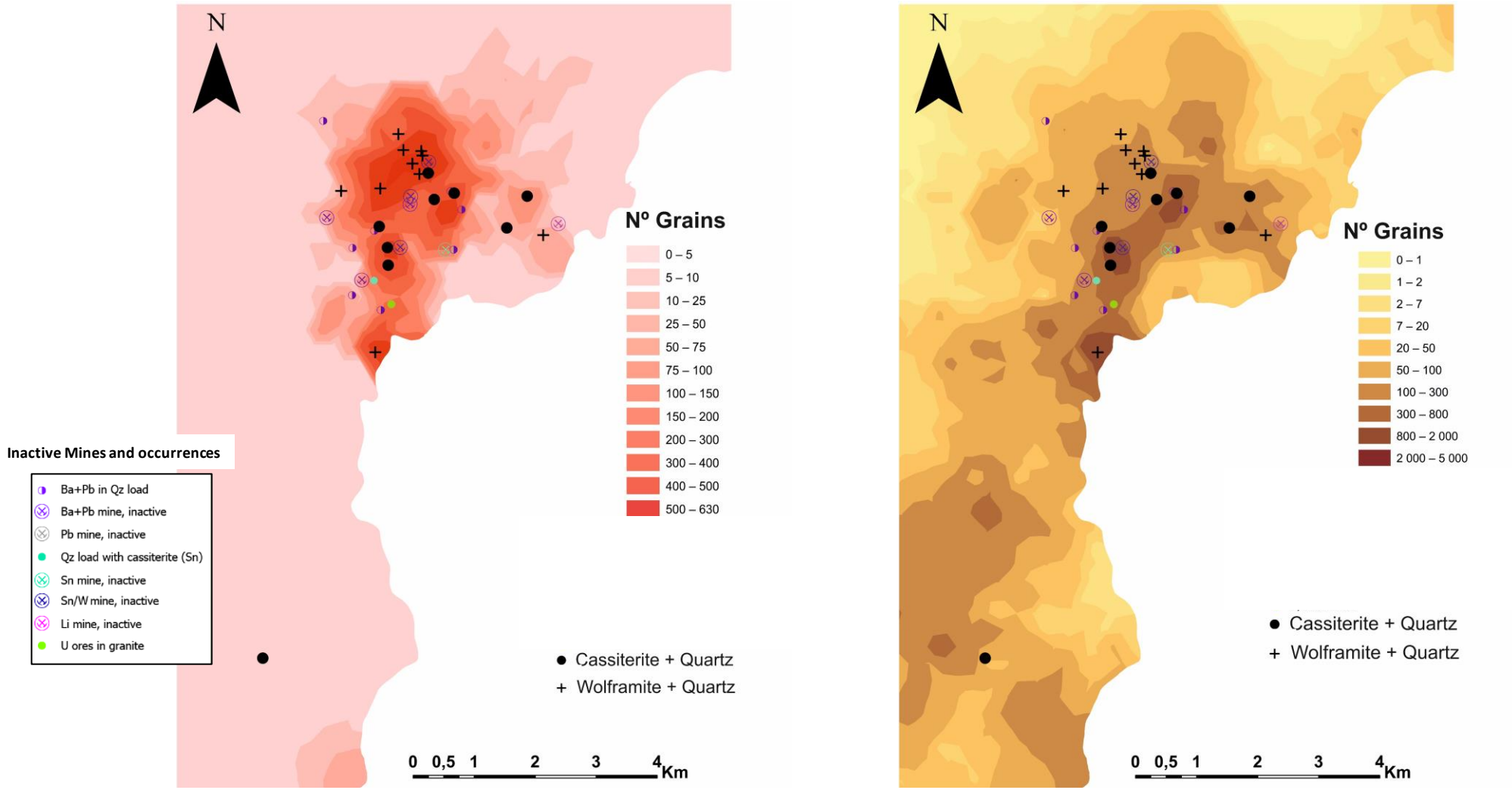






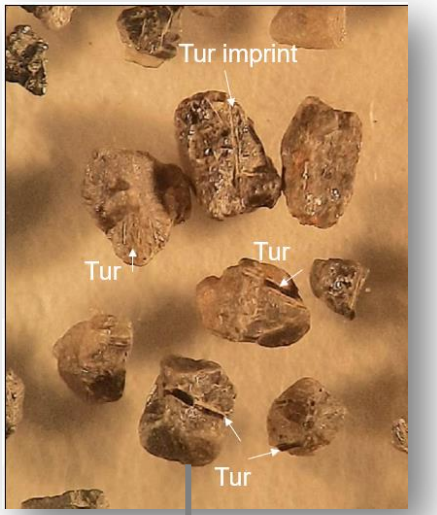
Garnet from Cordierite Granite Porphyry dyke associated with the Cabeza Araya Batholith (Corretgé and Suárez, 1994)

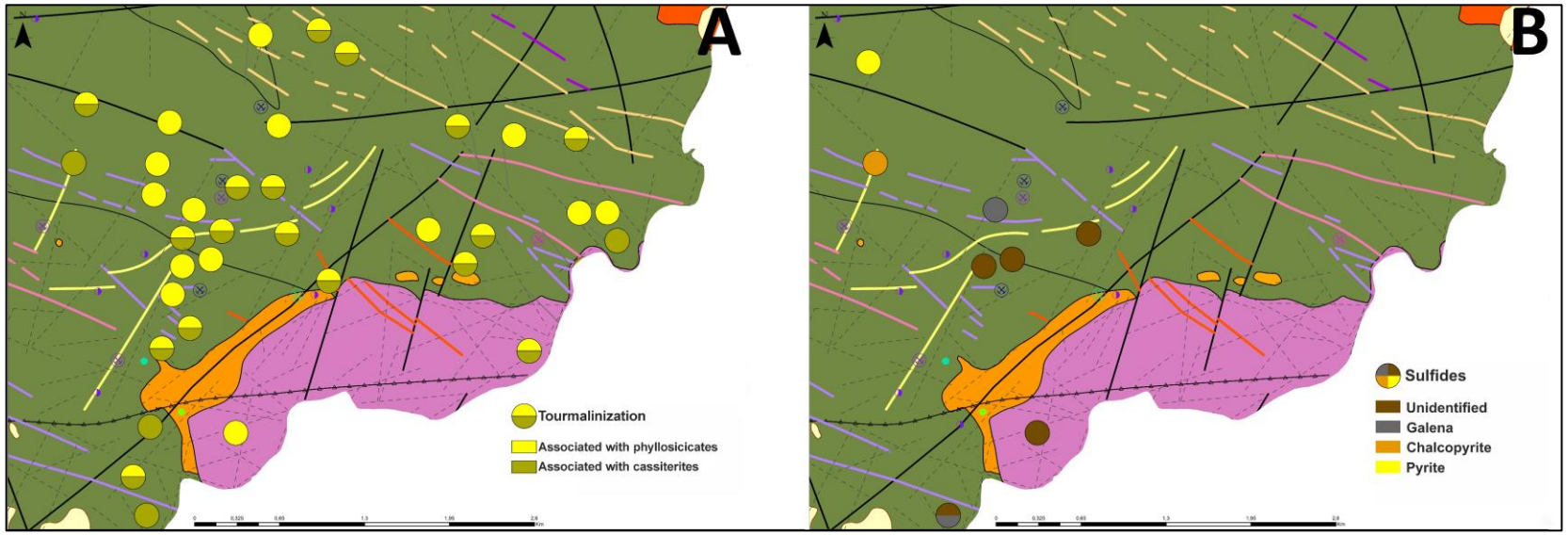
Composite Grains of Sn-W Ore Minerals & Quartz



Distribution of composite wolframite/cassiterite and quartz grains projected on the *Maps of the abundance by the total number of grains of wolframite and cassiterite; 647 samples data from LNEG old surveys in* which *are included the samples from Polygon 1 and 2. reassessed under the MOSTMEG project*

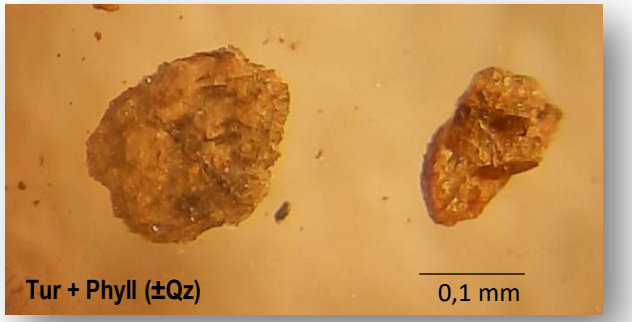
Composite Grains of Cassiterite or Phyllosilicates (± Quartz) & Tourmaline, and Sulphides



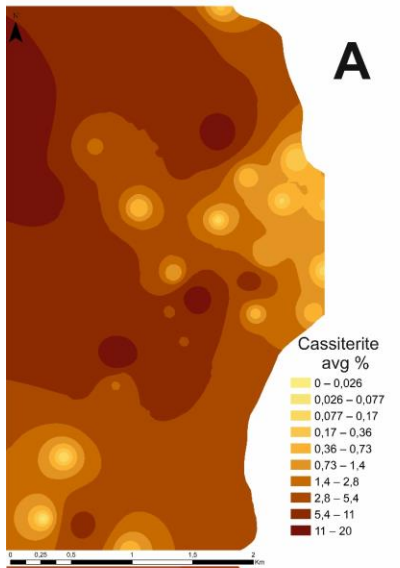


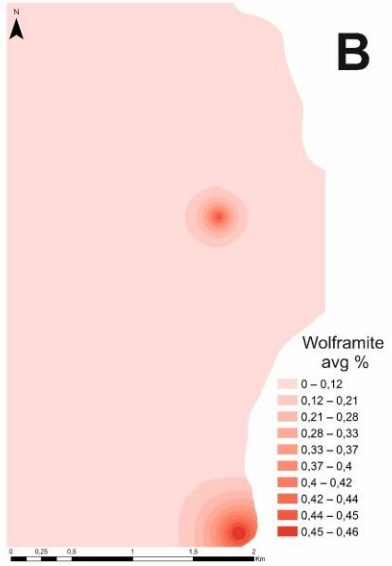
Tourmalinization: Sn-mineralisations; wall-rocks alteration or along the vein-wall-rocks contacts?

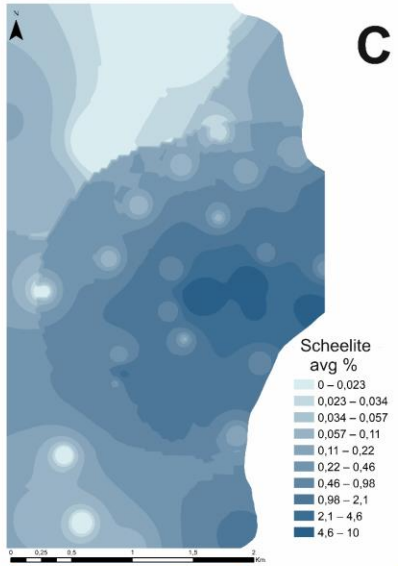
Sulphides: Sn-W and Ba-Pb, mineralisations.

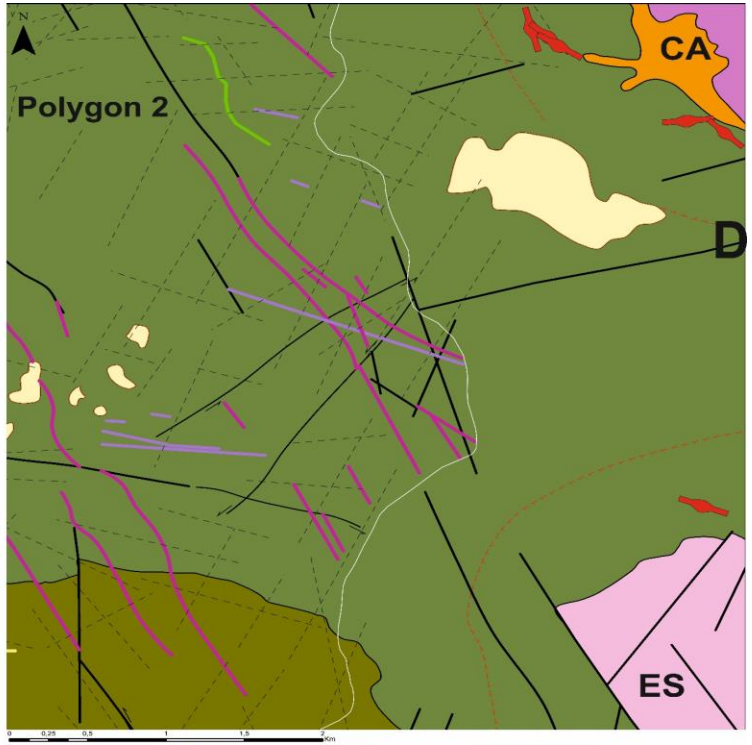


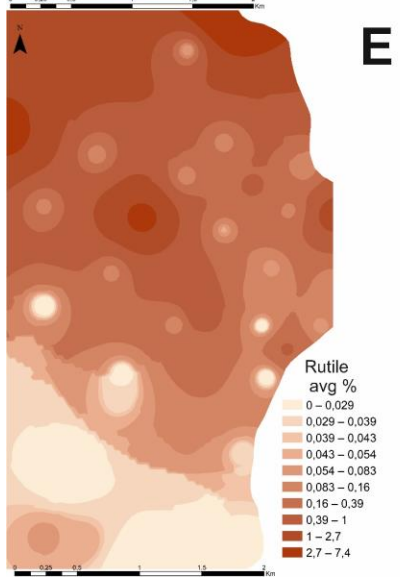
Segura Southern region (Polygon 2)_Mineral Average Abundance Maps
(total: 35 samples)

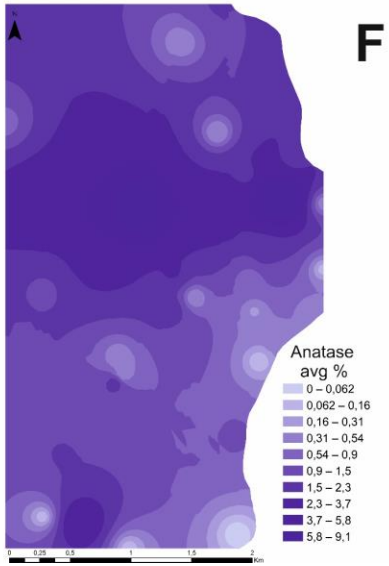


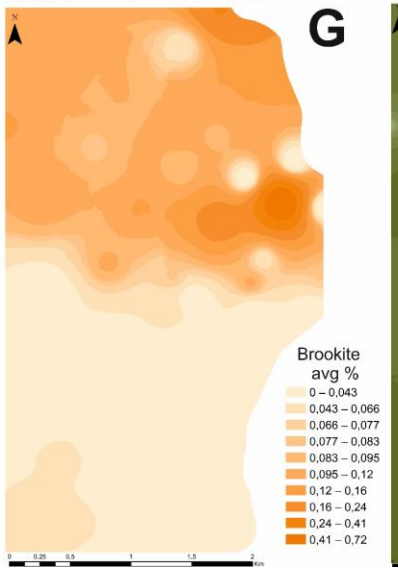


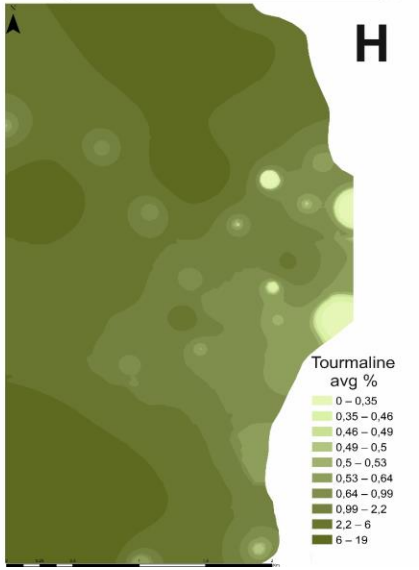


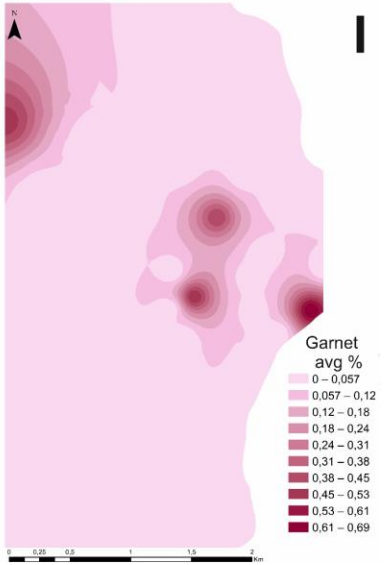




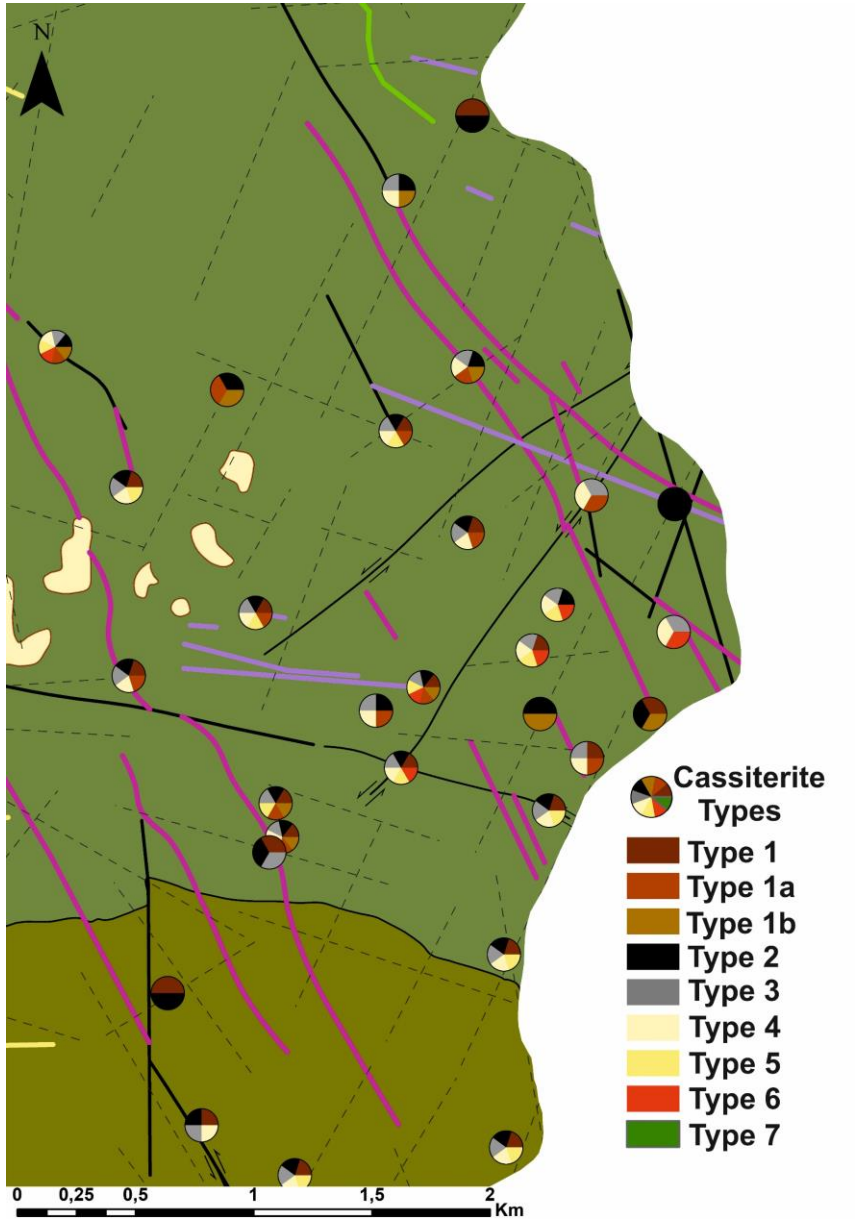


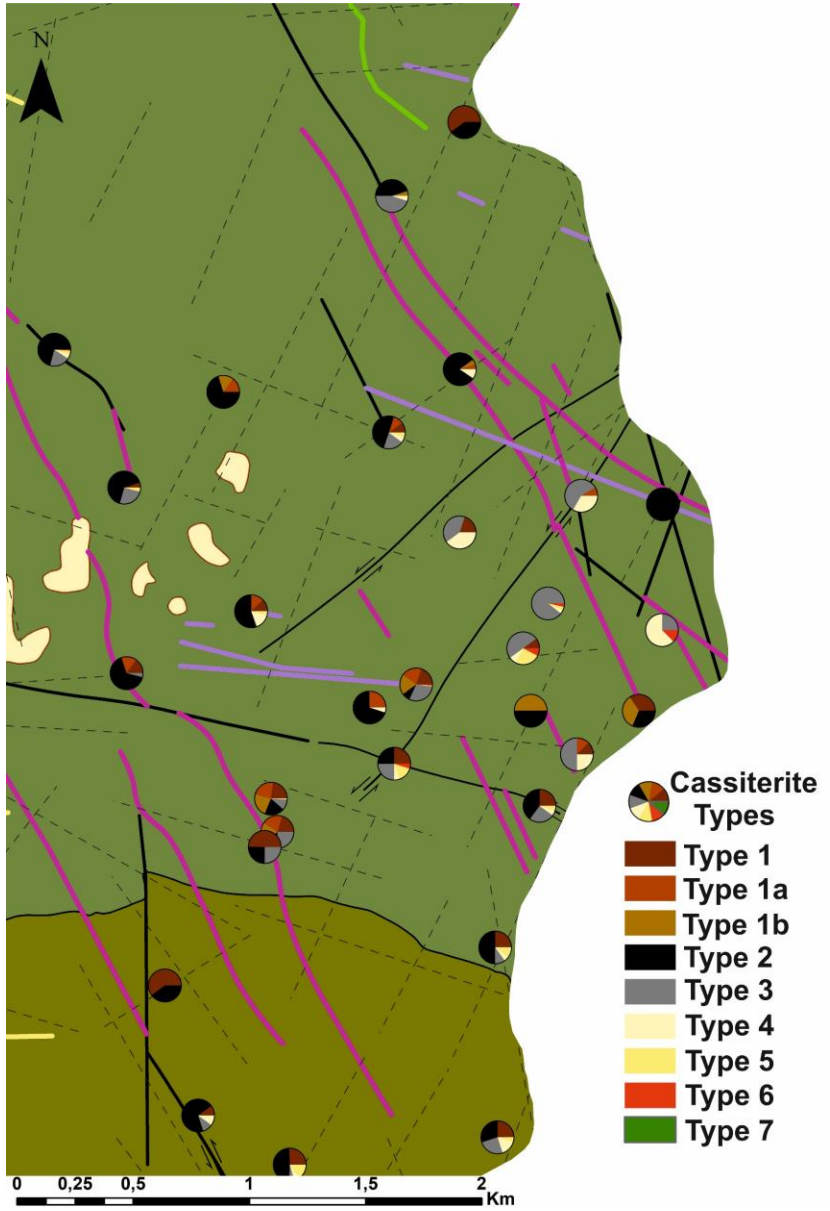




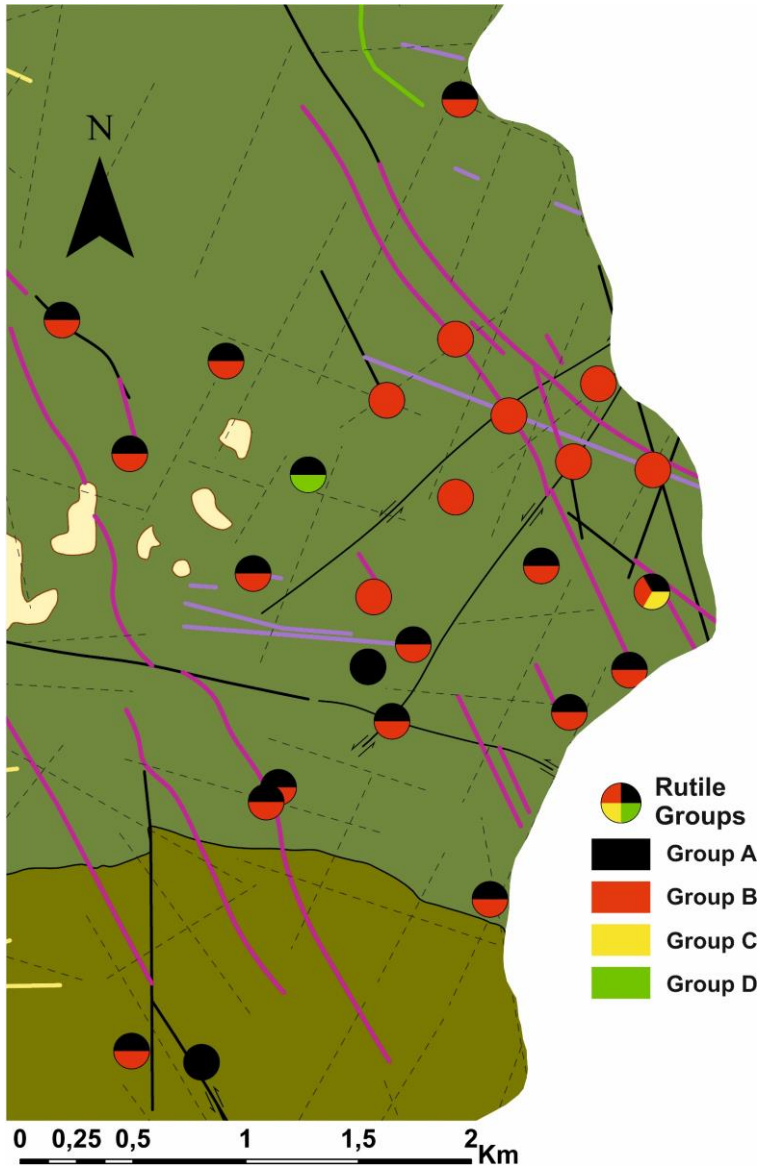


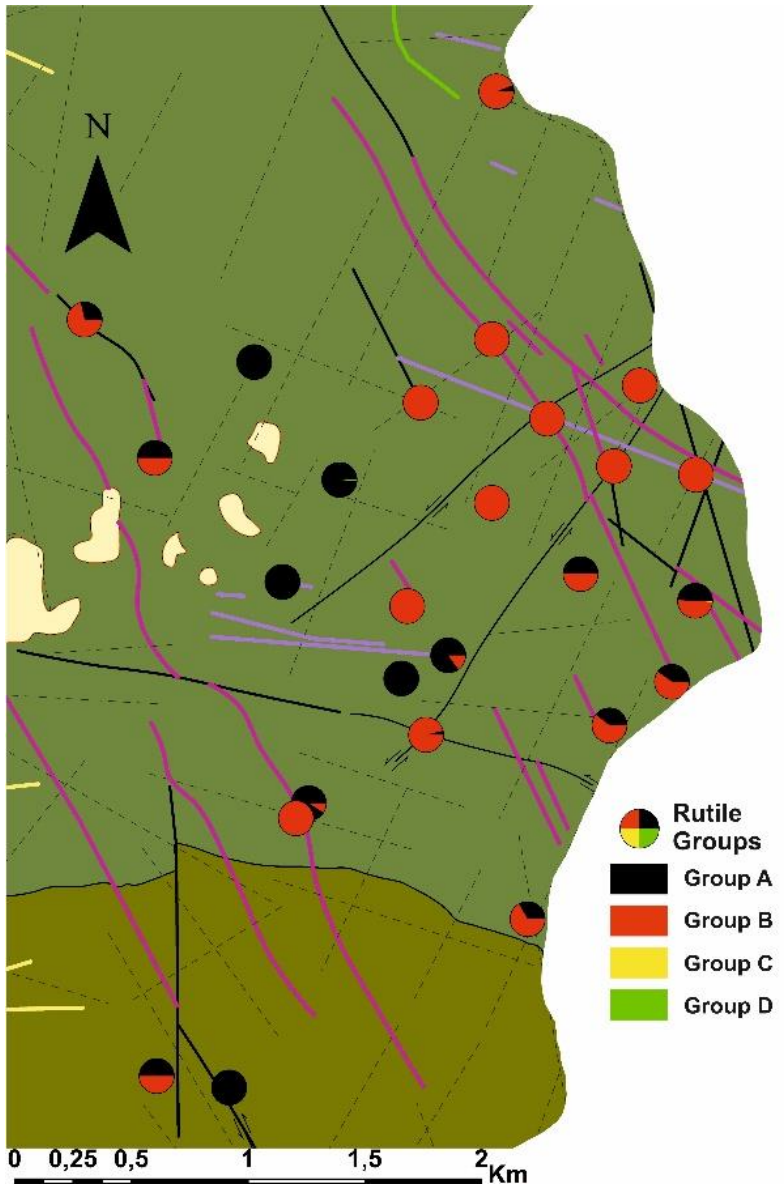
Cassiterite Grain Populations



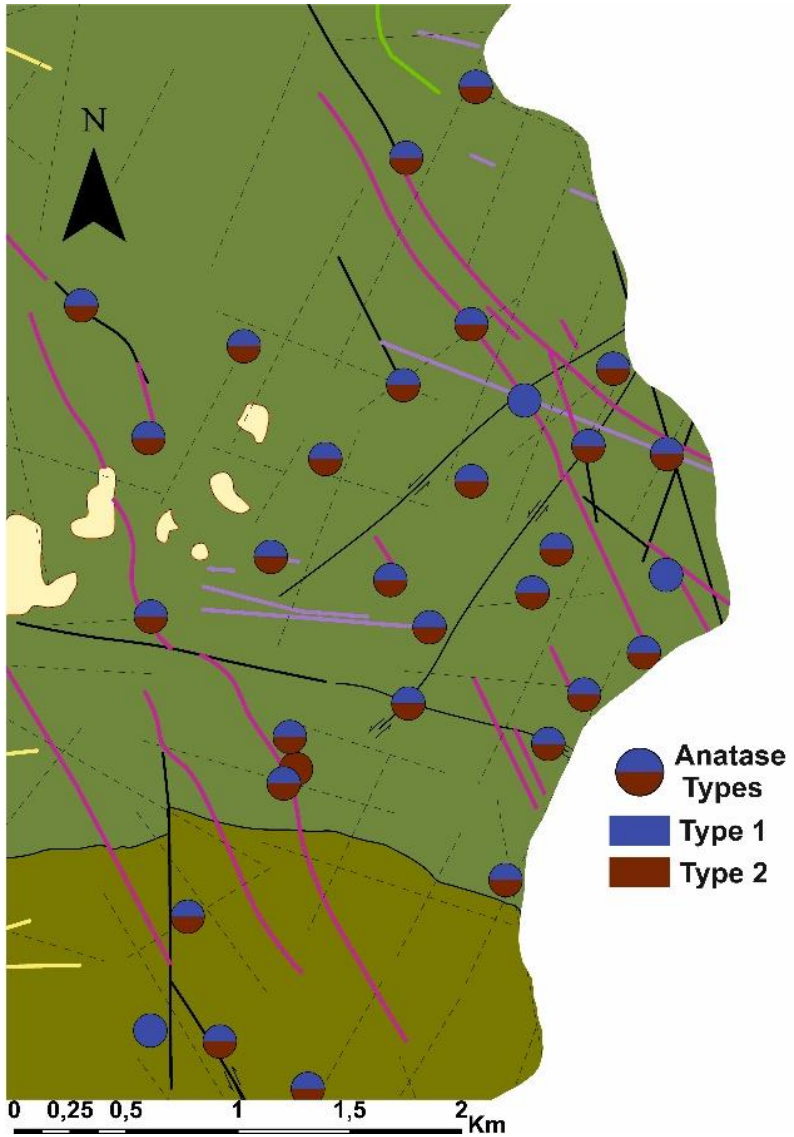


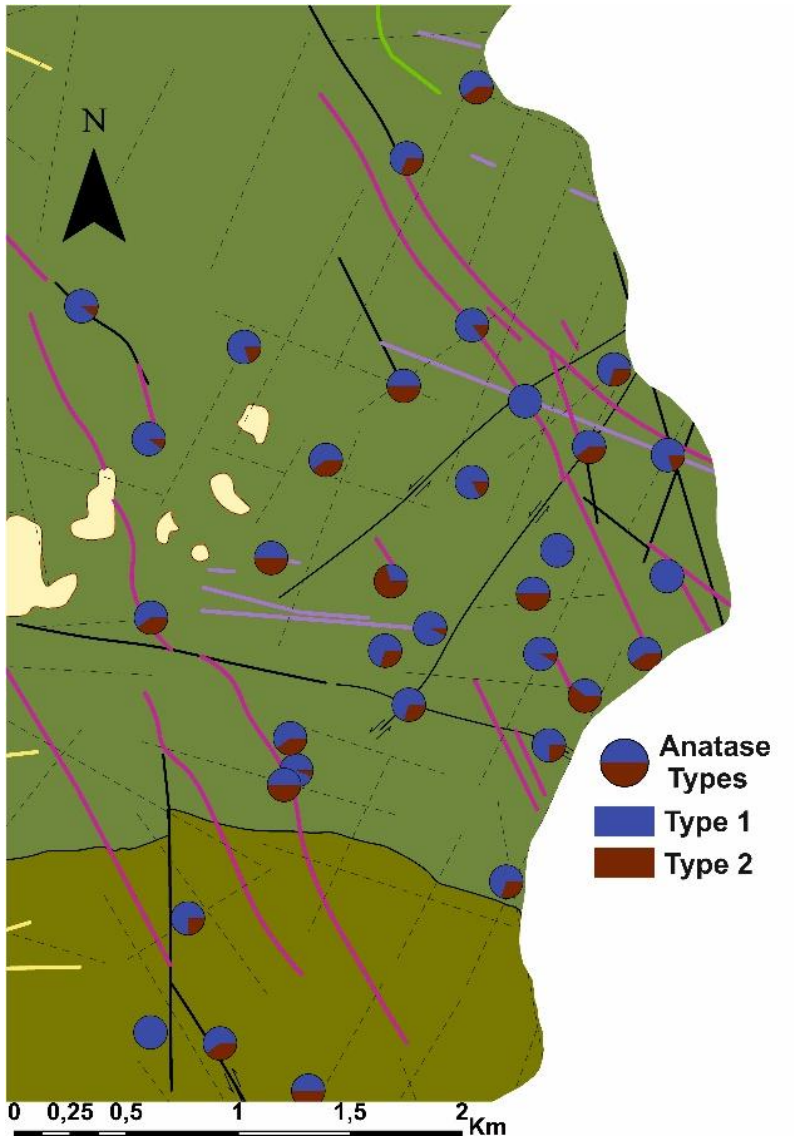
Rutile Grain Populations



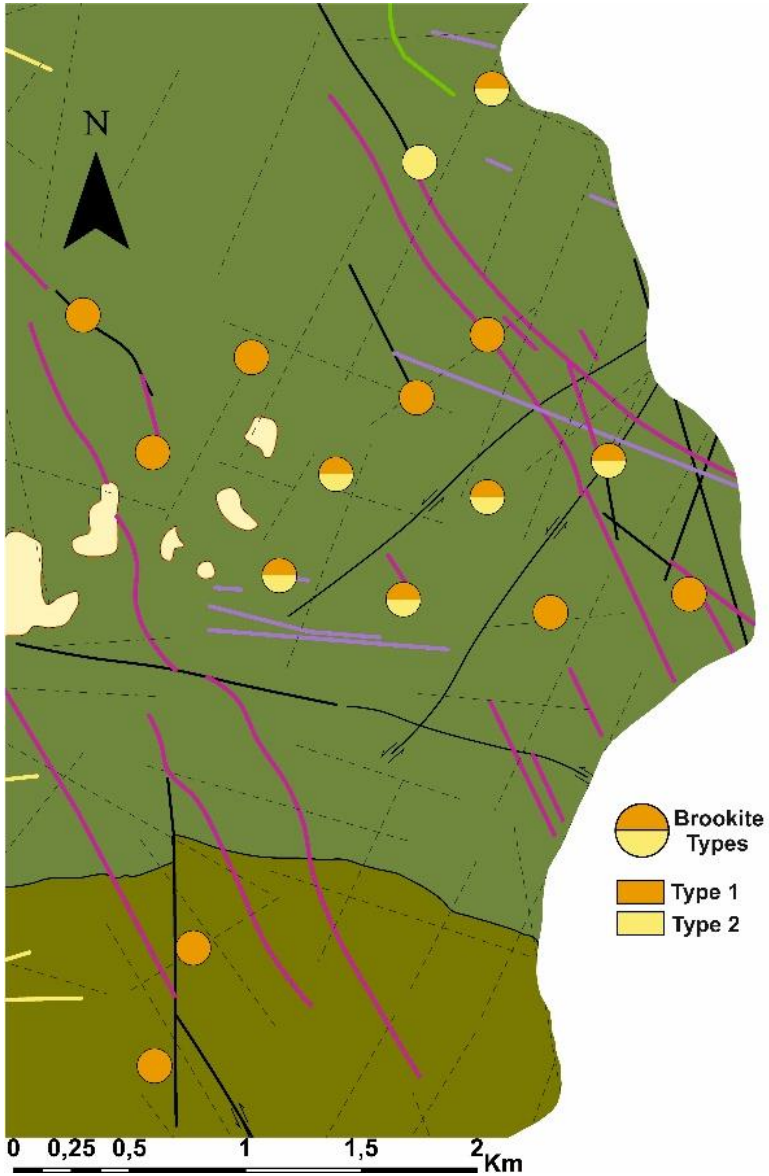


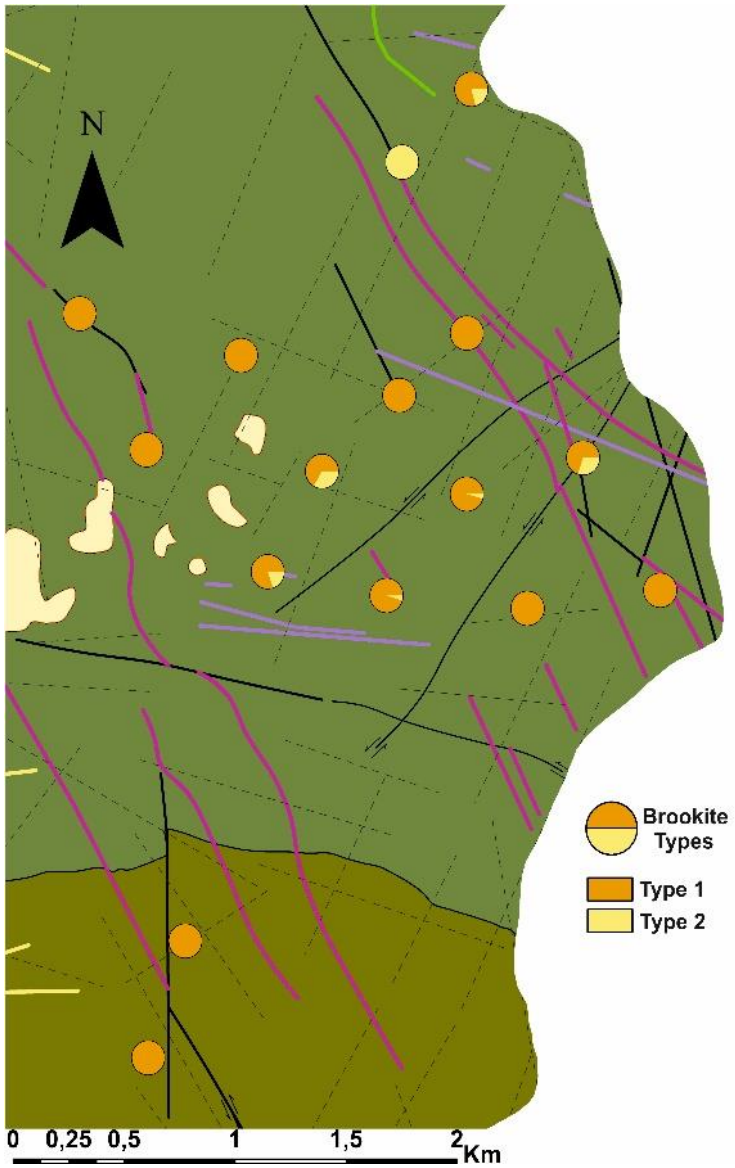
Anatase Grain Populations



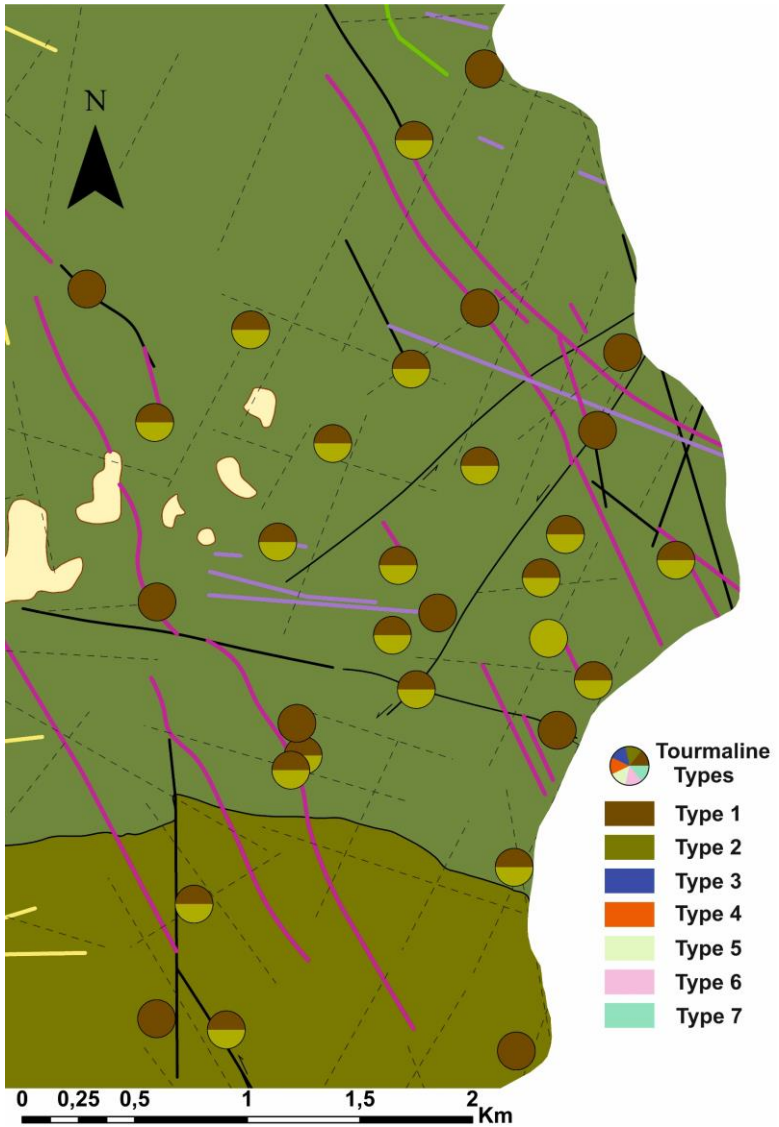


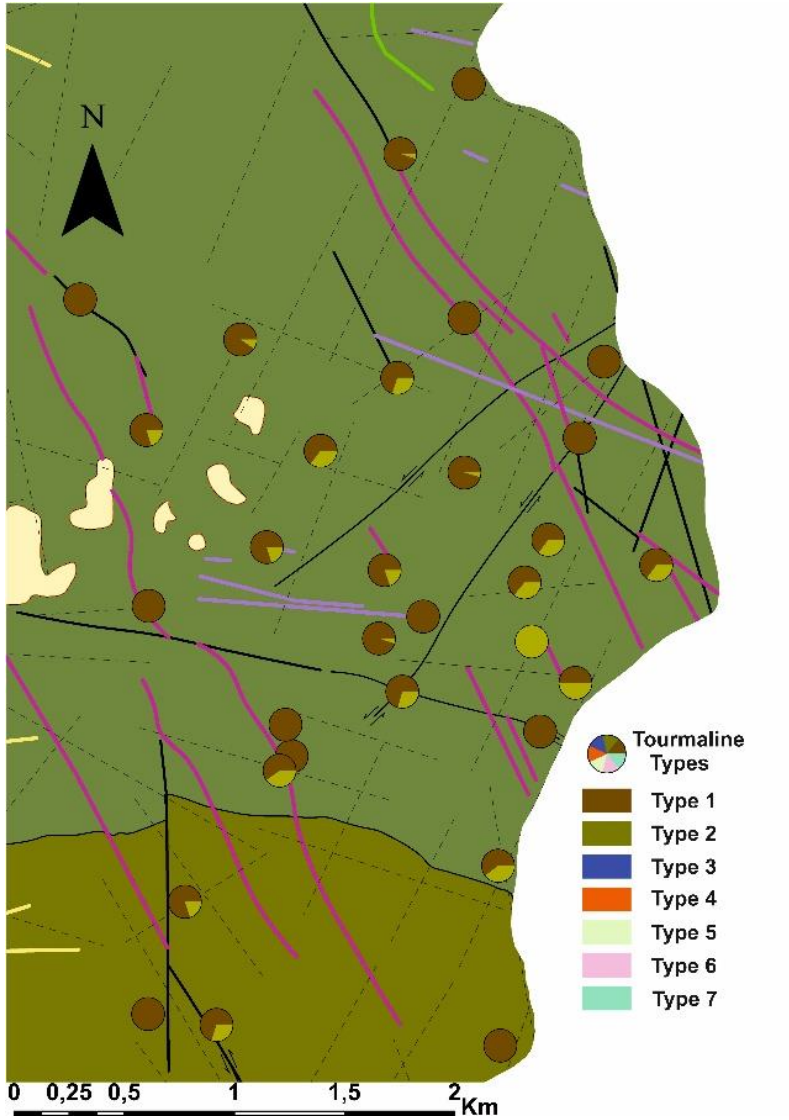
Brookite Grain Populations



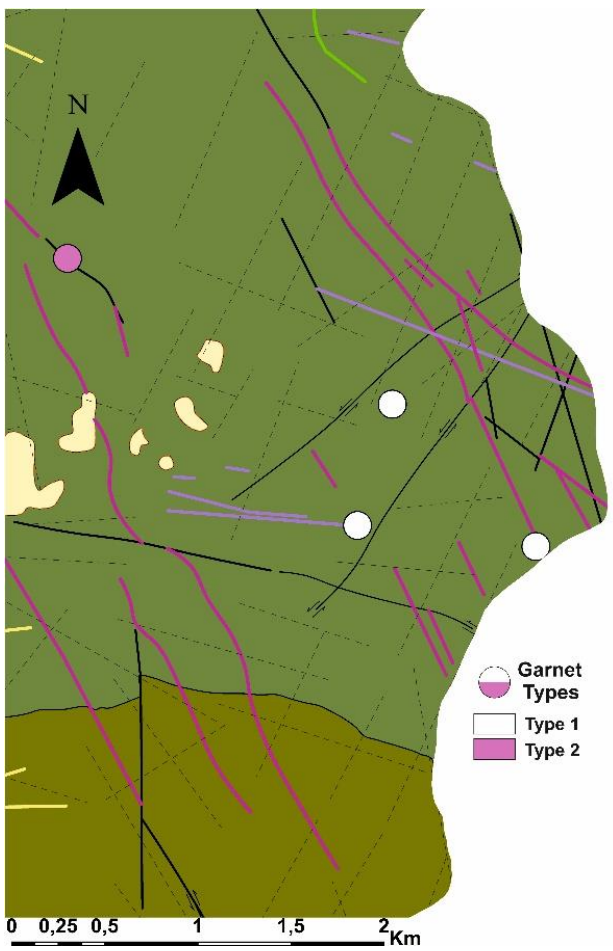


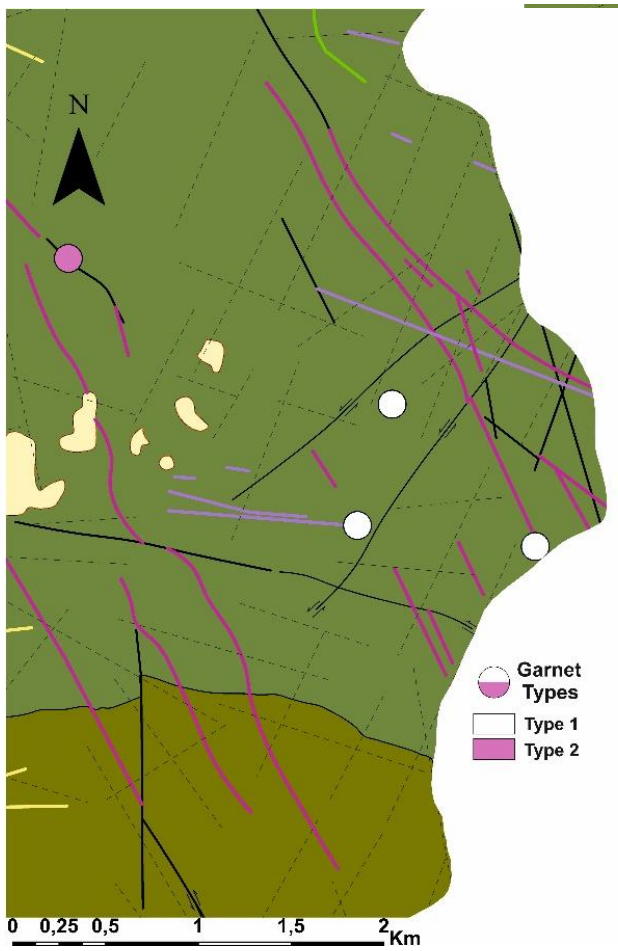
Tourmaline Grain Populations

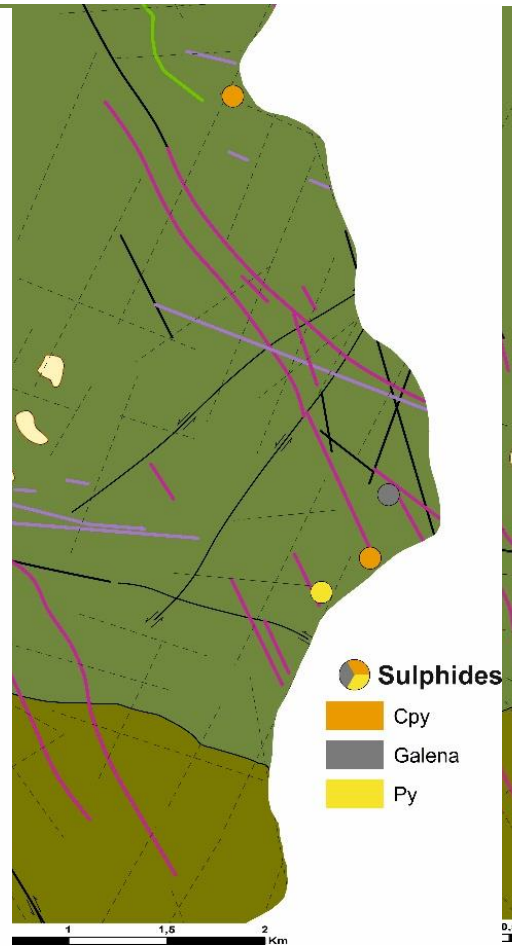


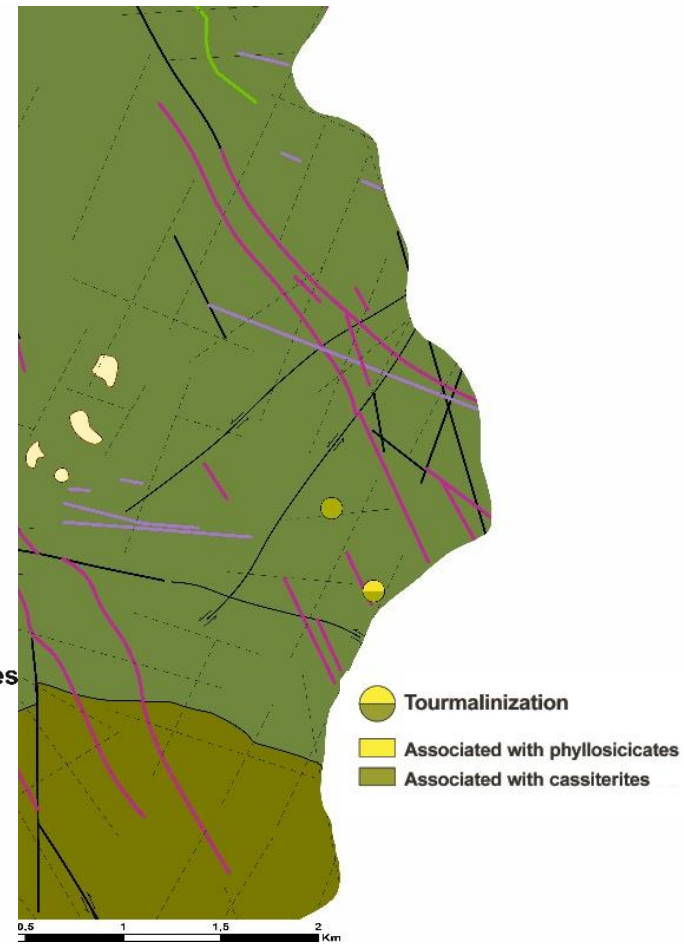


Garnet, Sulphides and Composite Grains of Cassiterite or Phyllosilicates & Tourmaline









Main Indicator & Pathfinder Minerals & Mineralogial Vectors

Metasediments
Increase of Fe Ox. Hydrox, altered minerals (± slate lithoclasts).

Granites
Tourmaline abundance increase in association with rutile, garnet (almandine), ilmenite, andalusite, zircon, biotite and muscovite.
Increasing in mineralogic and mineral populations variability;

Metassomatic Contact Halo s.l.
Scheelite, garnet (spessartine).

Tourmalinization s.l.
Tour+Phyllosilicates (±Qz)
(associated with hydrothermal Sn-W veins?)

Mineralisations
Cassiterite, wolframite;
Cass+Tour (± Cass+Qz, Wolf+Qz, sulphides s.l.);
Increasing in mineralogic and mineral populations variability.

Mineral Grain Populations Fingerprint

(Li-)Sn Magmatic ◄ ► **Sn-W Hydrothermal**

Thank You