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Study of the chromite mineralization associated to ophiolites from Tinos Island, Attico-Cycladic Massif

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Tinos chromitites appear in the ophiolite complex of Mount Tsiknia. The host rocks to the chromite orebodies are mostly serpentinites, meta-dunites, -peridotites, with minor -pyroxenites and locally-gabbros. Tinos Island is part of Cyclades Blueschist Unit (CBU), a nappe overlying a Pre-Alpidic anatectic basement covered by meta-volcanic and meta-sedimentary rocks (Bröcker and Franz, 2005; Rabillard et al., 2015). The whole sequence is underlain by the lowermost Basal Unit (BU), which comprises of Late-Triassic to -Cretaceous neritic meta-dolomites and -flysch (Xypolias et al., 2012), and overthrusted by an ofiolite slice (Katzir et al., 2000). These rocks have been metamorphosed at eclogite to blueschist facies conditions (Brichau et al., 2010) 53-40 Ma, and retrograded at greenschist to amphibolite facies at ≥ 25 and ~ 12 Ma (Bolhar et al., 2010). The whole sequence is intruded by a ~14 to 18 Ma monzogranite to granodiorite pluton, (Brichau et al., 2007), and a peripheral to it a boron- and fluorine-rich leucogranite (Mastrakas and St. Seymour, 2000), at the eastern part of the island. The intruded pluton resulted in contact metamorphism (Stolz et al., 1997) of pyroxene- and amphibole-hornfels and pyroxene-garnet skarns in the inner zone of the aureole, and albite-epidote hornfelses in the outer zone. The aim of the present work was to study the lithotypes, paragenesis and petrochemistry of Tinos chromitites of the host rocks. In combination with the mineral chemistry of chromite we also attempted to outline their genetic environment.

Materials and Methods

Sampling included the ultramafic host rocks, i.e., serpentinites, meta-dunites, -peridotites, -pyroxenites, -gabbros and greenschists as well as the chromitites of the ophiolite complex. From these samples a total of 48 polished and thin sections have been studied with optical microscopy, Scanning Electron Microscopy (SEM) and selected samples have been analyzed for their major and trace elements.

Results and Discussion

The mineral chemistry of the Tinos chromite indicates that chromite was in equilibrium with boninite melts originated from a Supra-Subduction Zone (SSZ), i.e., in a depleted mantle wedge. The chromites of Tinos have compositions which in the ternary Cr-Fe^{3+}-Al classification diagram of Stevens (1994) plot mostly in the field of Al-chromite and only a few samples in the field of Fe-chromite. The latter may represent the re-equilibrated margins of chromite grains. In the binary classification diagram for spinels the Tinos samples extend in the fields of Mg-chromite and chromite sensu strictu (figure 1). The ultramafic host rocks are dunites and harzburgites, characteristic rocks for the lithology of 'depleted mantle'.

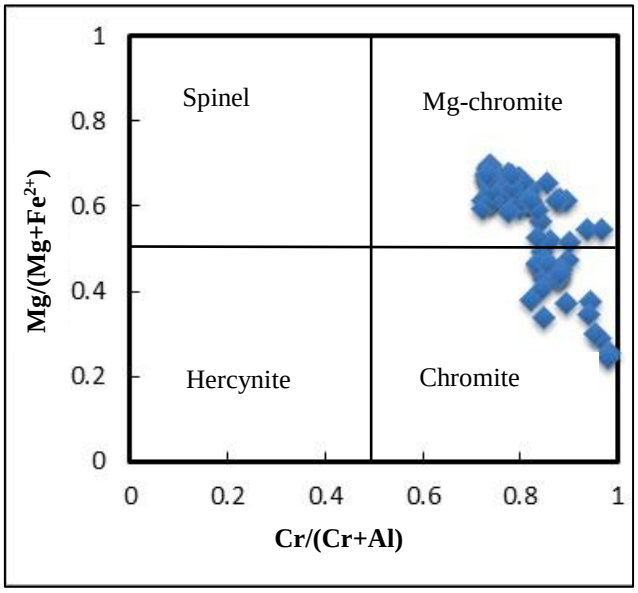

Figure 1. Analyzed chromites from the chromites of the ophiolithic complex in Mount Tsiknia on the Mg / (Mg + Fe^{+2}) vs. Cr / (Cr + Al) diagram.

A detailed petrographic study was carried out in order to examine the texture of the chromite crystals (figure 2A) and the presence of other metallic phases. Base metal sulfides such as pyrite, pyrrhotite, chalcopyrite, heazlewoodite have been identified which initially may have been in equilibrium with the ultramafic magma. However, the presence of galena, sphalerite, wurtzite and base metals antimonites (figure 2B) i.e., tennantite and alloys, as well as native Ni and Pb is probably linked to the metasomatic and/or hydrothermal processes, related to the emplacement of the neighboring Tinos composite granodiorite-leucogranite.

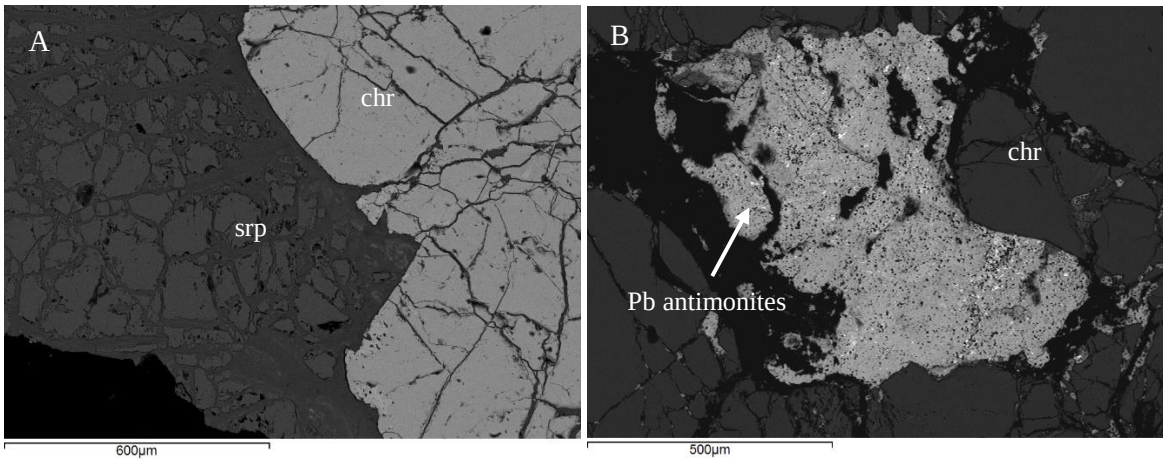

Figure 2. A) Chromite crystals in contact with the serpentinized mass, B) Pb-antimonites that appear to occupy the crystals of chromite. chr: chromite, srp: serpentine.

Conclusions

The following conclusions were drawn during the preparation of the study:

- The ultramafic host rocks are dunites and harzburgites, typical of 'depleted mantle'.
- Ore phases in intergrowths with chromite were identified, specifically of basic metal, sulfides and alloys, whether of primary or secondary origin.
- Tinos mineralization is related to the emplacement of Tinos composite granodiorite-leucogranite.

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