



Mineralogy and geochemistry of listwanite occurrences from the Othris ophiolite, Greece.

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Three small occurrences of extensively carbonate-altered serpentinite (listwanite) have been identified in East Othris at the ophiolitic formation of Vrinena, and in South Othris at the ophiolitic mélange formations of Agios Georgios and Paleokerasia. Their mineral assemblage includes calcite + quartz + chlorite + spinel ± clinopyroxene, as well as accessory Fe-oxides, titanite and apatite. Based upon their mineralogical composition they belong to the Type IB listwanite, characterized by the predominance of calcite and the presence of Mg-rich chlorite, mainly clinocllore and diabantite.

In the ophiolitic mélange formation of Agios Georgios listwanite was found in proximity with serpentinite (former harzburgite), which could be considered as the precursor protolith. Changes of major and minor elements between the listwanite and the protolith have been calculated based on the method for mass-balance analyses[1]. Results show that this listwanite resulted after metasomatic processes dominated by Ca enrichment. Sr, Y and Pb contents were also significantly increased, whereas rather moderate enrichments of Al, Mn, Cr and Cu also took place. Small reductions were observed for Mg and Ni. Si, Ti and Fe remained relatively immobile. The chondrite normalized REE patterns reveal significant enrichment of all analysed REE, and especially of the LREE [(La/Yb)_{CN}=20.4], and also with a negative Eu anomaly (Eu_{CN}/Eu*=0.79).

Spinel grains from the Agios Georgios listwanite and the adjacent serpentinite are in most elements compositionally similar. The listwanites from Agios Georgios, Paleokerasia and Vrinena all contain spinel grains. Their mineral chemistry is respectively: TiO₂=0.18-0.25; 0.04-0.10; 0.22-0.54 wt%, Al₂O₃=23.13-25.03; 27.69-29.70; 5.69-7.35 wt%, FeO=18.24-22.98; 16.44-19.49; 21.47-24.61 wt%, CaO= 0.01-0.07; 0.03-0.15; 0.01-0.28 wt%, Cr#=52.28-54.93; 45.57-48.85; 83.58-87.59, Mg#=51.07-65.39; 56.68-65.62; 46.77-55.35. Their rims exhibit slightly higher FeO and CaO contents compared to cores. Relict clinopyroxenes have been found in listwanite from Vrinena, classified as augites (Mg#=84.55-85.91; Wo=42.50-44.34; TiO₂=0.50-0.70 wt%).

The abundance of calcite and of REE enrichment indicate that the listwanite-forming metasomatic event occurred with hydrothermal circulation of a CO₂-rich fluid phase in a high water/rock ratio. REE mobilized mainly as REE-carbonate complexes under mildly alkaline conditions. Based upon the reciprocal slopes of the isocon method[2] the total mass gains are restricted, indicating that this hydrothermal alteration event occurred isochemically under mass preservation. Their formation is most likely associated with shallow level ocean-floor metasomatism, observed also in listwanites from the Iti ophiolitic mélange formation[3].

References: [1] Gresens 1967: Chemical Geol., 2, 47-65; [2] Grant 1986: Econ. Geol., 81, 1976-1982; [3] Tsikouras et al., 2006: Eur. J. Mineral. 18, 243-255.