New insights into the mineral chemistry of Au-bearing pyrite/As-pyrite/arsenopyrite concentrate from Olympias deposit, Kassandra mines (Chalkidiki, Greece)

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Pyrite/As-pyrite/arsenopyrite concentrate, derived from the flotation plant of the Olympias polymetallic deposit (http://www.eldoradogold.com/assets/europe/projects/olympias/), Kassandra mines (Chalkidiki, Greece), was investigated using a combination of microscopic, analytical and spectroscopic techniques. The sulfide mineral constituents were investigated using optical microscopy, XRD and SEM-EDS/WDS. The representative sample in study was found to contain 17 μg/g Au and 23 μg/g Ag, as well as Pb (0.524 wt.%), Sb (713 μg/g) and Cu (711 μg/g). Besides, it was found to contain significant amounts of Cd (55 μg/g), Sn (43 μg/g) and Ni (9 μg/g). The REE content of the material is very low ($\sum$REE+Y: 5 μg/g). This also stands for actinides (U: 1.4 μg/g; Th: 0.5 μg/g) giving a very low natural radioactivity, as indicated by gamma-ray spectroscopy (HPGe) measurements. Particular emphasis was given to the elucidation of the oxidation state of Au, by means of Au L_{III}-edge High Energy Resolution Fluorescence Detection X-ray Absorption spectroscopy (HERFD-XAS), in the Stanford Synchrotron Radiation Lightsource. According to preliminary results (see Figure below), Au exists in a higher oxidation state (e.g. $>Au^{3+}$) with rather limited Au^0. In that case, a coupled substitution mechanism of the type $Au^{3+} + Cu^{+} \leftrightarrow 2Fe^{2+}$, has been suggested in the literature to explain the incorporation of Au in pyrite.