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Publication date: 2017

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Vanadium in Al-ore (bauxite) from mines of central Greece

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Vanadium, either as critical metal extracted as by-product of other metal ores (e.g., [1]) or as potential hazardous element due to its involvement in red mud (RM) accident in Hungary (e.g., [2]), is an element of increased importance in aluminum mining and metallurgical industry. Recently, seawater-leaching experiments indicated significant V release from Greek RM and negligible for its parent Al-ore (bauxite) [3]. Acetic acid-leaching tests with the RM also indicated V release, as in the case of seawater [3]. While there is much debate on V in Hungarian, Greek and Australian RM [2–4], there are no advances concerning its partitioning and speciation in the mineral phases of bauxite. Commercial bauxite samples from mines of central Greece have been investigated -in bulk- by PXRD (incl. the clay fraction of 2-0.2μm) and ICP-MS, as well as, at the micro-/nano-scale using electron microscopy (SEM-WDS and TEM/HRTEM, after FIB-SEM -in selected areas previously checked by WDS- and Ar ion milling for microstructure observation) along with Synchrotron radiation (SR μ-XRF and μ-XAFS).

The measurements showed that V is mainly intercorrelated to Si, Ca and Mg (not to Al, Ti, Fe) in micro-areas between pisoliths, following the Si/Al ratio. The hosting phase is most likely a kaolinite-type clay (V up to 1400 ppm), and less probably boehmite. It predominantly occurs as $\text{V}^{5+}$ (although minor contribution of $\text{V}^{4+}$ cannot be excluded), indicating the existence of adsorbed $\text{V}$-anions, belonging to the series of metavanadate ($\text{VO}_{3}^{-}$) to decavanadate ($\text{V}_{10}\text{O}_{28}^{5-}$), rather than $\text{V}$-cations of lower oxidation state ($\text{V}^{4+}$/vanadyl/oxovanadium or even $\text{V}^{3+}$) substituting $\text{Al}^{3+}$ into the octahedral sheet of kaolinite-type structure [5,6]. It is therefore demonstrated that V is not related to Fe- and Fe-Ti-oxide minerals, despite their abundance in Al-ores, in contrast to its behaviour in other common basic metal ores [6].