

Graphite-bearing norites (Cortegana Igneous Complex, SW Spain): Mantle-derived carbon or crustal contamination?

R. PIÑA¹, E. CRESPO-FEO¹, L. ORTEGA¹,
J.F. BARRENECHEA^{1,2} AND F.J. LUQUE^{1,2}

¹Faculty of Geology, Univ. Complutense of Madrid, Spain

²Institute of Geosciences (UCM-CSIC), Madrid, Spain

The Cortegana Igneous Complex comprises a number of small lens-like intrusive mafic bodies (Tejadillas, Sojalva, El Merendero, La Caballona and Tabarca) located in the southern part of the Aracena Metamorphic Belt (Ossa-Morena Zone of the Iberian Massif). Among these bodies, the Sojalva stock is especially interesting due to the presence of abundant graphite in the igneous rocks (up to 26 wt.% C). Norite is the predominant lithology and consists of plagioclase (An₈₀₋₄₆), orthopyroxene (Mg#, 0.53-0.71) and minor biotite, along with cordierite, quartz, hercynite, graphite and Fe-Ni-Cu sulfides, mainly pyrrhotite and minor pentlandite and chalcopyrite. Partially-digested metamorphic xenoliths commonly occur in the igneous rock. The mineral assemblage (qtz+pl+bt+crd+grt+sil+sp) of these metamorphic xenoliths resembles that found in the high-grade gneisses and graphite-rich quartzites from the 'aluminous series' of the Aracena Metamorphic Belt.

Graphite occurs as flakes and aggregates of flakes both in the igneous rock and within the xenoliths. Graphite flakes in the igneous rock may reach up to 200x20 μm and they are usually associated with the sulfides which, in turn, are interstitial with respect to the silicate phases. Locally, small graphite flakes (less than 80 μm) are included within silicates (mostly cordierite, plagioclase and pyroxene).

The study of graphite by XRD reveals that it corresponds to the hexagonal poltype and has a high degree of structural order along the stacking direction (c-axis).

The stable carbon isotope ratios of bulk graphite samples are light, with $\delta^{13}\text{C}$ values ranging from -19.5 to -23.6 ‰. These values are compatible with biogenic carbon and point to derivation from the assimilation of metasedimentary rocks. This hypothesis is also in agreement with the mineralogical and textural features of the igneous rocks.

The results of this study reveal therefore that mantle-derived rocks may acquire their carbon content also by assimilation during their emplacement rather than from the mantle itself and that petrographic and isotopic studies are crucial to establish the ultimate origin of carbon in these rocks.

(Ba, Cu)(UO₂)₂(PO₄)₂.nH₂O solid solution occurrences from an uranyl-phosphate deposit in Portugal

A.J. PINTO^{1*}, M. GONÇALVES¹, C. PRAZERES²
AND M.J. BATISTA²

¹CREMINER, Dep. of Geology, Fac. of Sciences, Univ. of Lisbon, Ed. C6, Campo Grande 1749-016 Portugal
(*correspondence: afipinto@fc.ul.pt)

²LNEG, Laboratório Nacional de Energia e Geologia, Estrada da Portela, Alfragide, Ap. 7586 2611-901 Amadora

The occurrence of solid solution systems of both anionic and cationic substitution in secondary uranyl phosphate deposits is acknowledged in the scientific literature (e.g. [1] and [2]). Our work focuses on the Ba²⁺/Cu²⁺ substitution found in uranyl phosphates from Tarabau deposit, Nisa, Portugal, as depicted in the image below.

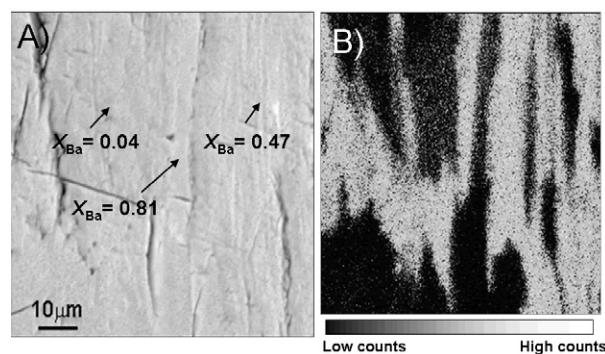


Figure 1: a) Backscattered electron micrograph of a (001) cleavage surface of a Ba-bearing uranyl-phosphate grain. Quantitative point analyses expressed in Ba mole fraction ($X_{\text{Ba}} = 1 - X_{\text{Cu}}$) are also included, b) Electron microprobe X-ray map relative to Ba on the surface shown in a).

A close inspection of the obtained results reveals that the studied materials are not chemically homogeneous, yielding intermediate compositions between pure Cu and Ba-endmember compositions. Moreover, an inverse relationship is found between surface composition in Ba and U, suggesting the occurrence of surface dissolution of a meta-torbernite substrate coupled with co-precipitation of an uranyl deficient (Ba, Cu) solid solution. Powder X-ray diffraction results point towards meta-torbernite-type structures, which implies that such phases are members of the meta-torbernite – meta-uranocircite solid solution system.

- [1] Jerden *et al.* (2003) *Chem. Geol.* **199**, 129–157.
[2] Yakubovich *et al.* (2008) *Cryst. Rep.* **53**(5), 764–770.