Archaeometric evidence of trade of leucite-bearing volcanic-made Roman mills of Pompeian style in NE Hispania (Spain)

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The leucite-bearing phonolitic and tephryphonolitic rocks of the ultraalkaline potassic province of Italy constitute a very characteristic volcanic suite unique in the circunmediterranean region. These porphyritic rocks are easily recognizable in macroscopic samples by the presence of milimetric to centimetric-sized phenocrysts and glomerules of leucite, and under the microscope and with EMPA can be well characterized attending to their texture and to the mineral chemisty of their green clinopyroxenes. These kind of cereal roman mills have been detected in a large number (more than twenty) at the Pompei excavations, [1] and are widespread over the italian peninsula [2]as well as also noticed in some north african roman sites [3, 4]. In North Spain their precence has been postuled [4] in two very distant sites (*Asturica Augusta* in NW Spain and *Emporium* in NE Spain) but, as far we know, never proved archaeometrically or documented archaeologically.

The recent findings at Barcelona downtown excavations (former *Barcino*) and outskits (former *Baetulo*, now Badalona) and near to *Caesaraugusta* (now Zaragoza) [5] have been petrographically proved and compared (by EPMA study of the mineral chemistry of green clinopyroxenes) of the known outcrops of these types of lava flows in Italy (volcano of Vico, Bagnoreggio, Orvieto, Roccamonfina). All available data strongly supports an origin of the volcanic rocks employed in the mills at the Vulsino Volcanic District (Northern Roman Volcanic province, Italy), a fact that implies an specific and important trade way of heavy industrial instruments around I-II centuries AC.

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Quantification of rapid environmental redox processes using quick-scanning X-ray absorption spectroscopy (Q-XAS)

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In the environment, chemical reactions at the mineral/water interface occur over a range of temporal scales, ranging from microseconds to years. Many important mineral surface processes (e.g., adsorption, oxidation-reduction, precipitation) are characterized by a rapid initial reaction on time-scales of milliseconds to minutes. Knowledge of these initial reaction rates is critical to determining chemical kinetic rate constants and reaction mechanisms. Kinetic measurements, using traditional techniques typically yield only a few data points during the initial phases of the reaction and cannot capture important reaction rates occurring on time-scales of seconds or faster. Chemical relaxation techniques allow rapid data collection on time-scales of milliseconds. However, rate 'constants' are calculated from linearized rate equations, which include parameters that are determined from equilibrium and modeling studies. Consequently, the rate 'constants' are not directly determined.

Direct, *in situ*, molecular-scale measurement of rapid environmental reactions has, until recently been quite limited. Recently, we have developed an approach using quick-scanning X-ray absorption spectroscopy (Q-XAS) to investigate environmental redox reactions at time-scales ranging from sub second to several minutes. We have applied this technique to investigate As(III) and Cr(III) oxidation kinetics by Mn(IV) oxides. Additionally, we have investigated the formation of As(III) and Cr(III) surface precipitates on Mn(IV) oxide surfaces.