

## Adsorption of gold nanoparticles on pyrite: an experimental study

YUHONG FU<sup>1,2</sup>, SUXING LUO<sup>1</sup>, XIN NIE<sup>1</sup>, ZONGHUA QIN<sup>1</sup> AND QUAN WAN<sup>1\*</sup>

<sup>1</sup> Institute of Geochemistry, Chinese Academy of Sciences, Guiyang, Guizhou 550081, P.R. China

(\*correspondence: wanquan@vip.gyig.ac.cn)

<sup>2</sup> Guizhou Normal University, Guiyang, Guizhou 550001, P.R. China

Natural and engineered nanoparticles are ubiquitous in the earth environment, and would participate in various mineral-water interfacial interactions. Among them, sorption of nanoparticles on minerals is thought to have fundamental implications to many geochemical and environmental processes. However, till now the mechanism of nanoparticle sorption on minerals is still poorly understood.

We studied the sorption of gold nanoparticles (AuNPs) on pyrite [1], partly because natural AuNPs were often found in pyrite of Carlin-type gold deposits. AuNPs (10~80nm) were synthesized using Frens method [2], while natural pyrite was sieved and cleaned before the sorption experiments. Aqueous nano-gold sols (10ml) were mixed with pyrite powders (0.5g) for a definite time under different pH and atmospheres. Atomic absorption spectroscopy was used to monitor the Au and Fe concentrations in the liquid phase, and electron microscopy was used to characterize the morphological changes.

It was found that pyrite was highly susceptible to oxidation, resulting in a decrease in the system pH and an increase in the isoelectric point ( $pH_{iep}$ ) of pyrite. When the system was very acidic ( $pH < pH_{iep}$  after days of pyrite oxidation or through artificial pH adjustment), the oxidized pyrite surface became positively charged and could completely adsorb negatively charged AuNPs by electrostatic attraction. Under initially alkaline conditions, iron oxide or hydroxide colloids might form through oxidation, leading to partial adsorption of AuNPs. Pyrite with a smaller size had a larger specific surface area and a faster oxidation rate, and thus adsorbed AuNPs more strongly. At  $pH < 4$ , compared with AuNPs with larger size, smaller-size AuNPs were more rapidly adsorbed by pyrite possibly due to larger surface charge density.

[1] Fu *et al.* (2017) *J. Nanosci. Nanotechnol.*, in press. [2] Frens (1973) *Nature (London), Phys. Sci.* **241**, 20-22.