

## The fate of elements through the transformation from schwertmannite to goethite: An example from the Chinkuashih acid mine drainage area, northern Taiwan

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Metastable schwertmannite plays an important role in the attenuation of trace elements from acid mine drainage (AMD) but its transformation into goethite through aging may change such a process. This study analyzed depth-dependent variations of ionic sorption/desorption behaviors in AMD deposition profiles collected from Gold Falls (pH = 2.8) and its lower reaches in the Chinkuashih AMD area, northern Taiwan. With increasing depth, a transformation sequence from schwertmannite, poorly crystalline goethite to better crystallized goethite was characterized by XRD, FTIR, SEM, and TEM. The surface schwertmannites contained variable compositions but invariably had partitioning factors in the order of As > Cr > Cu > Al > Mn, Zn, Ni, Co, Cd, Pb, relative to the associated water samples. Bulk composition analyses indicated increases of Fe and Cu concentrations and decreases of sulfate and Cr contents with rather small variations in As and Al as the sample depth increases. Selective extraction of samples from 3 depth profiles with ammonium oxalate solution at pH 3 showed the following behaviors: (1) the Fe and As concentrations of the schwertmannite and poorly crystalline goethite were similar but lower than that of the better crystallized goethite; (2) most sulfate ions were desorbed from the samples of all depths but much lower desorbed fractions of Al, arsenate, Cu, and Cr were recorded for the better crystallized goethite as compared to those desorbed by the schwertmannite and poorly crystalline goethite; (3) the poorly crystalline goethite exhibited a Cu desorption fraction much lower than that of the schwertmannite but both had nearly equal Cr desorption capacities; (4) the fraction of desorbed Cr was much greater than that of As desorbed from the poorly crystalline goethite. The data suggest that As, Cr, and Cu were respectively retained, released, and accumulated during the transformation from schwertmannite to goethite, in which the formation of poorly crystalline goethite was closely involved. Such a transition phase may largely affect the solution chemistry and sorption behaviors of elements in other AMD environments as well.

## Laser post-ionization secondary neutral TOF-MS for isotopic analysis of pre-solar grains

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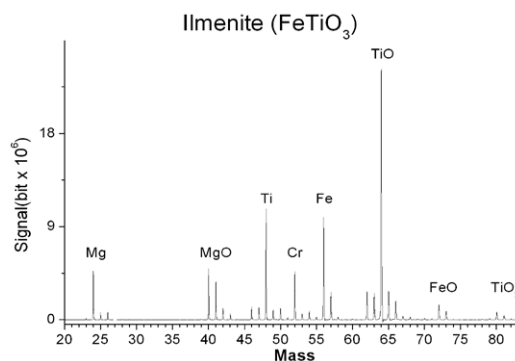
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Aiming for high-sensitivity, wide-mass-range isotopic analysis of comet grains from the STARDUST mission, a new laser post-ionization secondary neutral (LPI-SNMS) TOF-MS instrument named DUST-BUSTER is being developed at the IES in Taiwan [1]. The design is based on that of the SPIRIT instrument at ANL because of its extremely high 'useful yield' (ions detected / atoms consumed) around 25% for Mo which is more than ten times that for SIMS [2]. A 157nm F<sub>2</sub> laser is used to ionize the secondary neutral, allowing elements with ionization potential less than 8 eV to be ionized efficiently by single photon ionization. The wide-mass coverage was achieved with TOF. Our design goal was to detect isotope shifts larger than 10% at a 3 sigma level using only a few thousand ions. In favorable cases (e.g. Mo), this criterion corresponds to all of the total atoms of a minor isotope of a major element in a 100 nm grain. So far we have analyzed 10 isotope ratios in 5 elements in geological samples and found that for isotopes without severe interferences (e.g. <sup>46</sup>Ti/<sup>48</sup>Ti measured from both Ti and TiO in FeTiO<sub>3</sub> whose spectrum is shown below) our precision approaches our design goal.

LPI-SNMS by DUST-BUSTER from sample Ilmenite



[1] Chen *et al.* (2005) *LPS*, **36**, abstract#1373. [2] Veryovkin *et al.* (2005) *Nucl. Instr. & Meth. B* **241**, 356–360.