Surface chemistry of minerals and tektites as constrained by X-Ray Photoelectron Spectroscopy. Giuseppe G. Biino, Institute of Mineralogy and Petrography, University of Fribourg, Perolles, CH-1700; & Materials Sciences Division, Lawrence Berkeley Nat. Lab., Berkeley, Ca 94720 USA. giuseppe@electron.lbl.gov

X-ray photoelectron spectroscopy (XPS) is a valuable tool to investigate the chemical composition and chemical environment of elements at surface of solids. The aim of this study is to provide a XPS systematic investigation of some minerals (micas, feldspar, garnet, Al2SiO5) and tektites. XPS yields chemical information on the near surface that are accurate (5 %) and reproducible (0.1 %). Every mineral surface produced in air shows a coating by adventitious material (mainly C). The chemical composition of random oriented mineral samples is close to stoichiometry, but XPS measurements at grazing angle (small probing depth) along a major crystallographic direction clearly evidence the chemical anisotropy of minerals lattice. For example, the chemical composition of kyanite surface perpendicular to the main cleavage plane is Si-richer (i.e. cleavage exposes silicon). The chemistry of (001) natural micas is also never stoichiometric.

XPS provides the experimental evidence that natural micas (apparently unaltered) often cleave along very thin chlorite, talc, gibbsite and kaolinite interlayers or along graphite-rich inclusions planes. These criptic interlayers evidences the beginning of weathering. The interlayered phases change mechanical properties of micas and perturb the Rb-Sr and K-Ar isotopic systems. Muscovite equilibrated at very high pressure recrystallised as phengitic muscovite, but shows very thin Al-rich (gibbsite-like) interlayer. This interlayer may not be related to weathering but to lack of Al transport during very high pressure re-equilibration.

Tektite is a natural glass formed from terrestrial material melted and displaced by the impact of an extraterrestrial body. Surface- near-surface composition of tektite results from different processes like fractionation during flying, impact and post solidification weathering. One goal of this study was to evaluate the importance of weathering on fractionation during flying. Surface chemical composition of a tektite from a arid area is compared to chemical composition of a tektite from a humid climate. XPS reveals that the surface chemistry differently evolved in the two tektite and both show the presence of a well developed leached layer comparable to that observed in weathered glasses. Other processes than fractionation during flying and impact are responsible for the chemical composition of the surface-near-surface. The enrichment in N observed one tektite is related to interactions between glass and fluid buffered by the organic material in the soil. The chemical environment of oxygen was also investigated. Oxygen chemical environment suggests that the depolymerization of tektite is comparable to artificial silicate melts.