Hydrogen depth profiling by p-p scattering in nominally anhydrous minerals

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Hydrogen has been shown to occur as a trace element in many nominally anhydrous minerals. The presence of hydrogen in several of the major minerals in the Earth's mantle has received attention, due to the possibility that these phases provide a significant hydrogen reservoir. Recently an experimental and analytical procedure for hydrogen measurements in thin mineral samples by proton-proton scattering has been developed at the Lund Nuclear Microprobe facility. An annular surface barrier detector, divided in two insulated halves, is used to detect the scattered proton and the recoiled proton in coincidence. The summed energy of each detected proton pair can be used to produce depth profiles if the individual scattering angles are known. The easiest case is when only a small difference in energy between each detected proton pair is allowed, i.e. scattering angles very close to 45 degrees. This limitation criterion considerably reduces the statistics. For this reason the analytical method has been expanded to use the full detector area (35-55°) and to identify the scattering angles individually for each hydrogen event.

Nominally anhydrous minerals, both synthesized and of natural occurrence, with hydrogen concentrations from 10 ppm to 100 ppm have been analysed. Hydrous minerals, as well as Mylar foils were used as standards. Depth profiles show that intrinsic hydrogen can be distinguished from surface contaminations, e.g. water adsorbed on the sample surfaces. Also the detection limit and depth resolution of the method has been investigated.