Lorandite from Allchar, a long-term double detector for pp-neutrinos and fast myons

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The Sb-As-Tl-Au deposit at Allchar, providing one of the world-wide largest concentrations of thallium and also numerous other Tl-bearing minerals, may open an outstanding scientific perspective. Allchar belongs to the Serbian – Macedonian metallogenic province located near the border between Macedonia and Greece. By a long-lasting international research it has been shown that Lorandite from Allchar can serve, together with cogenetic monitor minerals, as a geochemical detector for both, the flux of solar pp-neutrinos, averaged over the geological age of Lorandite, and for the average flux of fast cosmic myons within the same period of time.
By the capture of (mainly) solar pp-neutrinos with an unprecedented low threshold of only 52 keV for them, ^{205}Tl is transformed to ^{205}Pb. Our investigations show that about 22 atoms ^{205}Pb in 1g Lorandite for the geological time range of 4.2 Ma and a palaeozoic depth of 570 m should be expected, by supposing the present solar neutrino luminosity and by taking into account its reduction due to neutrino flavour oscillations. However, an additional production of ^{205}Pb occurs via the interaction of cosmic radiation (stopped and fast myons) with decay products of ^{238}U and ^{232}Th. The amount of this "underground" of ^{205}Pb depends on the palaeozoic depth (actual depth plus eroded sheets) and the geological age of of the Tl-mineralization. Calculations based on known nuclear cross-sections show that fast myons generate by far the largest part of "underground" ^{205}Pb atoms. The present state of research predicts, for palaeozoic depths of 350 m and 570 m, respectively, total numbers of 106 and 48 ^{205}Pb atoms per gram of Lorandite for 4.2 Ma, whereby the contributions from fast myons add up to 84 and 26 atoms of ^{205}Pb, respectively. For the detection of the few ^{205}Pb atoms we will apply SMS (Schotty Mass Spectrometry) at the ion storage ring of GSI (Gesellschaft für Schwerionenforschung, Darmstadt), where single fully-stripped ^{205}Pb ions can be detected.
References:
1. Proceedings of the International Symposium on Solar Neutrino Detection with 205Tl, Dubrovnik, Yugoslavia 1990, ed. By M. K. Pavicevic and G. Amthauer, Beih. N. Jb. Miner. Abh. 2/3, 125 (1994)

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